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USER'S GUIDE FOR THE  
NIMBUS 7 ERB  
SOLAR ANALYSIS TAPE (ESAT)

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August 1984

National Aeronautics and  
Space Administration

Goddard Space Flight Center  
Greenbelt, Maryland 20771

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NIMBUS 7 ERB  
SOLAR ANALYSIS TAPE (ESAT)

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## PREFACE

The NIMBUS 7 Earth Radiation Budget (ERB) data set activity is being conducted by NASA, Goddard Space Flight Center. Launched on October 24, 1978 the NIMBUS 7 satellite would have been considered successful if its several experiments had gathered useful data covering one complete year. Nearly six years later over half of the experiments, including the ERB, are in good operating condition and are expected to continue to collect data for several more years.

Monitoring the solar irradiance and its fluctuations is an important part of the ERB experiment. The ERB Solar Analysis Tape (ESAT) has been developed to make these solar observations available to the scientific community in a compact form. This first ESAT contains five years of solar data covering the period November 16, 1978 to October 31, 1983. Additional solar analysis tapes will be issued on a yearly basis as the data is processed.

The NIMBUS 7 ERB Experiment has been guided by the ERB NIMBUS Experiment Team (NET) whose members are listed below. The original NET members were competitively chosen by a NASA Announcement of Opportunity issued in the fall of 1975. Later the NET elected to membership certain individuals who had made a considerable contribution to the scientific success of the experiment. The ERB solar sensors were furnished by Eppley Laboratory, Inc. and John Hickey, of Eppley Laboratory, has taken the lead in the quality control and analysis of the solar data. All the ERB orbital and daily mean solar data on the ESAT were provided by John Hickey. Solar plage data were provided by Kenneth Schatten and Nate Miller of NASA/GSFC. The ERB Solar Analysis Tape and this User's Guide were put together at Goddard by Research and Data Systems, Inc. under NASA contract NAS 5-27728. This was done under the guidance of H. Lee Kyle, NASA/GSFC, and of John Hickey.

The authors wish to thank Bradley Alton of Eppley Laboratories for his assistance in constructing the improved ERB solar data set; Mitch Weiss (RDS) for the development of software to convert and test the ERB solar data in its final form on ESAT; and Scott Salomonson (RDS) for entering key solar activity parameters into the computer.

## ERB NIMBUS EXPERIMENT TEAM (NET) MEMBERS

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**	Campbell, G.G.	CIRA, Colorado State University
***	Coulson, K.L.	University of California, Davis
	Hickey, J.R.	Eppley Lab., Inc.
	House, F.B.	Drexel University
	Ingersoll, A.P.	California Inst. of Technology
*	Jacobowitz, H.	NOAA/NESDIS
**	Kyle, H.L.	NASA/GSFC
**	Maschhoff, R.H.	Gulton Industries, Inc.
	Smith, G.L.	NASA/LaRC
	Stowe, L.L.	NOAA/NESDIS
	Vonder Haar, T.H.	Colorado State University

- \* Jacobowitz was elected team leader in 1976.  
He was succeeded in 1983 by Kyle.
- \*\* Elected Members.
- \*\*\* Left the NET because of other commitments.

# ERB SOLAR ANALYSIS TAPE (ESAT) USER'S GUIDE

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# ESAT USER'S GUIDE

## 1.0 INTRODUCTION

A compact Nimbus-7 ERB Solar Analysis Tape (ESAT) data set has been compiled to facilitate the solar science community's access to ERB solar measurements. These measurements include the total solar irradiance and six spectral regions as listed in Table 1-1. The first ESAT tape contains a collection of five years of solar data derived from the ERB Solar and Earth Flux Data Tapes (SEFDT). This data set will contain the orbital solar data as derived from the SEFDT and the computed daily mean solar data derived from the SEFDT by Eppley Laboratories. The data set covers the period from November 16, 1978 to October 31, 1983. The ERB instrument is normally on 3 out of every 4 days and makes approximately 14 solar observations per day. The SEFDTs contain the raw counts and calibrated irradiances for each observation period whereas only one average irradiance value per channel per observation is given on the ESAT. For inclusion on the ESAT, the SEFDT data has been carefully sorted and questionable observations rejected. Certain common solar activity indicators are also included on the ESAT to facilitate analysis of the data. Data will be available on one (1) 1600 BPI Computer Compatible Tape (CCT). Supplemental ESAT tapes will be made as the ERB data becomes available. Each supplemental tape is expected to contain one year of data in the same format as the first tape.

### 1.1 Description of ESAT User's Guide

The ESAT User's Guide will describe the contents of the ERB Solar Analysis Tape (ESAT), the origins of ESAT data, method of processing and corrections to the data. A brief review of the Nimbus-7 Earth Radiation Budget (ERB) experiment and overview of solar activity indicators useful to satellite-based solar-terrestrial studies is included. This User's Guide will serve as the principal document for the ESAT by the user community.

Table 1-1  
Characteristics of ERE Solar Channels

Channel	Sensor (c) Type	Wavelength Limits ( $\mu\text{m}$ )	Filter	Solar Irradiance (d) Air Mass Zero ( $\text{Wm}^{-2}$ )	Gain	Noise Equivalent Irradiance ( $\text{Wm}^{-2}$ )
1	N3	0.2 - 3.8	Suprasil W	1370	692.3	$1.77 \times 10^{-2}$
2 (a)	N3	0.2 - 3.8	Suprasil W	1370	685.8	$1.77 \times 10^{-2}$
3	N3	(0.2 to) 50	None	1370	607.2	$1.43 \times 10^{-2}$
4	N3	0.526 - 2.8	OG530	970	974.5	$1.94 \times 10^{-2}$
5	N3	0.698 - 2.8	RG695	679	1339.4	$1.91 \times 10^{-2}$
6	N3	0.395 - 0.508	Interference Filter	206	8512.7	$3.58 \times 10^{-2}$
7	N3	0.344 - 0.460	"	166	17964.7	$5.73 \times 10^{-2}$
8	N3	0.300 - 0.410	"	109	26985.3	$7.55 \times 10^{-2}$
9	K2	0.275 - 0.360	"	57	9808.6	$0.94 \times 10^{-2}$
10C(b)	H-F	(0.2 to) 50	None	1370	2791.0	$2.39 \times 10^{-2}$

Notes: (a) Channels 1 and 2 are redundant. Channel 1 is normally shuttered and is opened periodically to adjust value of Channel 2.

(b) Channel 10C is a self-calibrating cavity channel added to Nimbus 7 and replacing a UV channel on Nimbus 6.

(c) All are types of Eppley wire wound thermopiles.

(d) Values obtained from adjusted Nimbus 6 results.

- The unencumbered FOV for all channels is 10 degrees; the maximum field is 26 degrees for Channels 1 through 8 and 10C. The maximum FOV for Channel 9 is 28 degrees.

## 2.0 BACKGROUND

### 2.1 Background of Nimbus-7 and ERB Experiment

A brief background on the Nimbus-7 ERB experiment is presented here. The user is referred to Jacobowitz, et al., (1984) for more detailed descriptions of Nimbus-7 and the ERB experiment. The Nimbus-7 spacecraft was launched on October 24, 1978 and placed into a 955 km, sun-synchronous polar orbit with ascending-node and descending-node equator crossings at noon and midnight respectively. The orbital period is about 104.16 minutes.

The Earth Radiation Budget (ERB) experiment is one of seven experiments aboard the Nimbus-7. The objectives of the ERB experiment are twofold. First, to determine, over a one year period, the radiation budget of the earth by simultaneous measurement of:

- (1) Incoming solar radiation
- (2) Outgoing earth reflected (shortwave) and earth emitted (longwave) radiation;

and second, to develop angular models of the reflection and emission of radiation from clouds and earth surfaces (Taylor, et al., 1983a, 1983b, 1984)

### 2.2 Operational Schedule

The ERB instrument normally operates on a three-day-on, one-day-off duty cycle. The first operational science data were available from November 16, 1978. The first data year starts on November 1, 1978 and December 1978 is considered the first month of monthly and seasonal products. The ESAT data starts on November 16, 1978. As of the summer 1984, high quality solar data was still being received from the ERB instrument and we expect to continue to receive data for several more years.

### 2.3 ERB Solar Channels

Incoming solar radiation is measured by ten spectral channels. Measurements are taken as the satellite crosses the southern terminator heading northwards. Table 1-1 lists the characteristics of the solar channels. Figure 2-1 shows the ERB solar channel responses superimposed on the 1971 NASA Standard Curve of Extraterrestrial Solar Spectral Irradiance. Figure 2-2 shows a cross-sectional drawing of the typical-filtered solar channel.

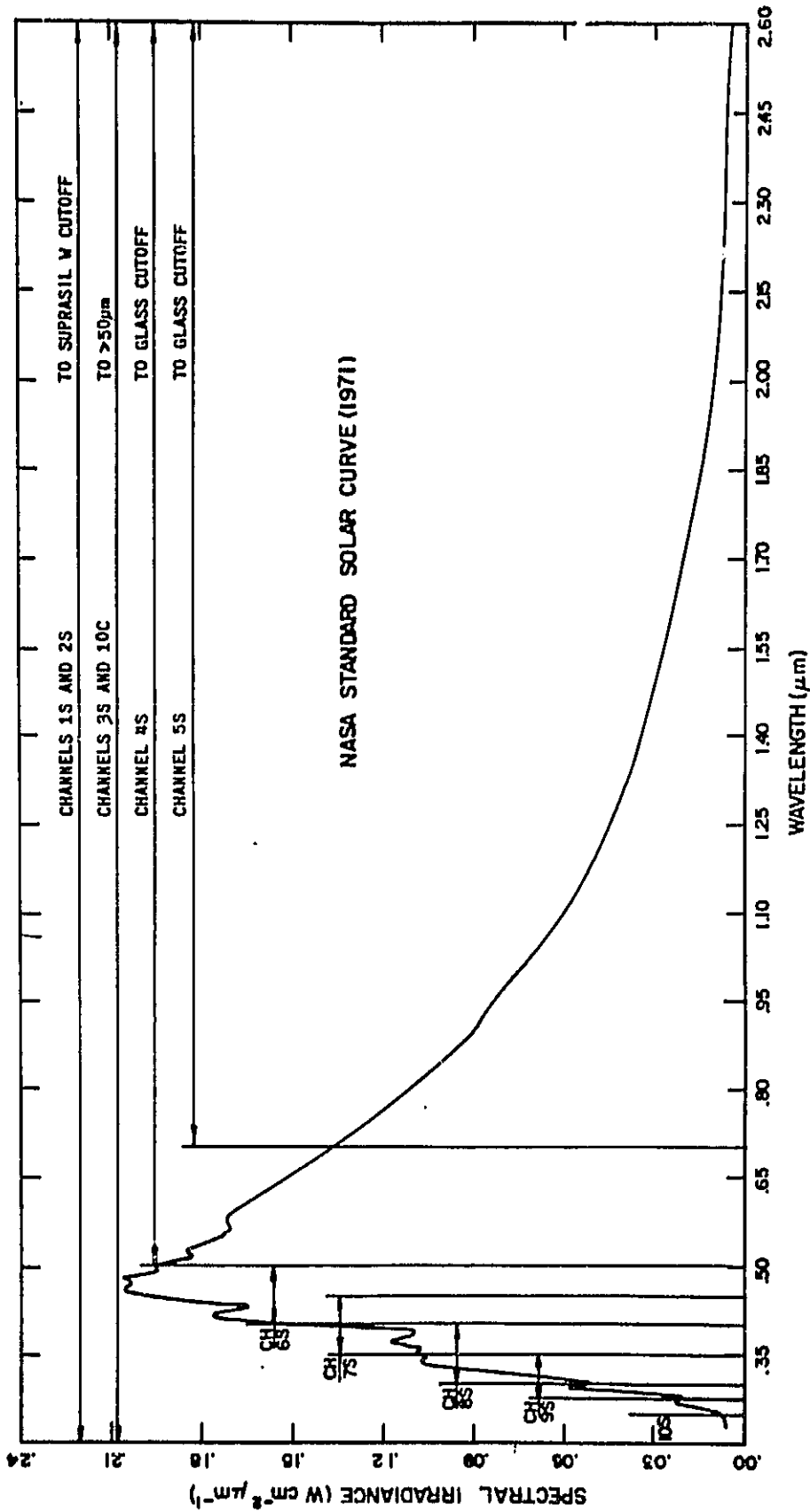


Figure 2-1. Spectral Intervals Monitored by the ERB Solar Channels (With 1971 NASA Standard Extraterrestrial Solar Curve)

Incoming radiation enters the sensor through a protective window. After passing through a spectral filter, it passes through a second window and strikes a 3M (Inc.) black-painted thermopile detector surface. The first protective window minimizes the effects of charged particles, whereas the second window reduces the effects of solar heating of the filter and reradiation to the detector. The whole interior of the cell was anodized to reduce the reflection of solar radiation onto the detector.

Each of the 10 solar channels is an independent, individual modular element with a mated amplifier as part of the unit. The sensors are advanced versions of wire-wound type thermopiles. There are no imaging optics in the solar channels—only filters, windows, and apertures. No optical amplification is required to maintain high signal-to-noise ratios because of the high thermopile sensitivities and state-of-the-art electronics used. Channels 1 and 2 are duplicate, channel 1 being the reference for channel 2 for the in-flight calibration program. Channel 1 is normally shuttered.

Channels 4 and 5 contain broad bandpass filters with transmittance spectra matching those of the standard Schott glasses, OG530 and RG695, of the World Meteorological Organization. The interference filters on channels 6-9 are deposited on Suprasil W (grade 3) fused silica substrates to minimize degradation. Blocking outside the primary transmission bands is achieved by interface layers only. No radiation absorbing glasses are used.

The spectral intervals in the  $0.2 \mu\text{m}$  to  $0.526 \mu\text{m}$ ,  $0.526 \mu\text{m}$  to  $0.695 \mu\text{m}$ , and  $0.20 \mu\text{m}$  to  $0.695 \mu\text{m}$  range is obtained by differential treatment of the channel 4 and 5 data together with readings obtained from channel 2. Channels 1 through 8 have type N3 thermopiles; channel 9 has type K2. Channel 10C has a modified model H-F self-calibrating cavity element. The cavity is mounted onto a circular wire-wound thermopile. The electric heater used for self calibration is energized when a "GO/NO GO" heater command is issued. The thermopile output and the heater voltage and current are then submultiplexed into the channel 10C data system.

The solar channel assembly is located on the side of the spacecraft facing in the direction of spacecraft motion. The assembly can be rotated  $20^\circ$  in  $1^\circ$  steps to either side of the spacecraft's forward direction in order to acquire an on-axis view of the sun under the expected variation of the satellite orbit plane with respect to the sun. The Solar channels were included on the ERB

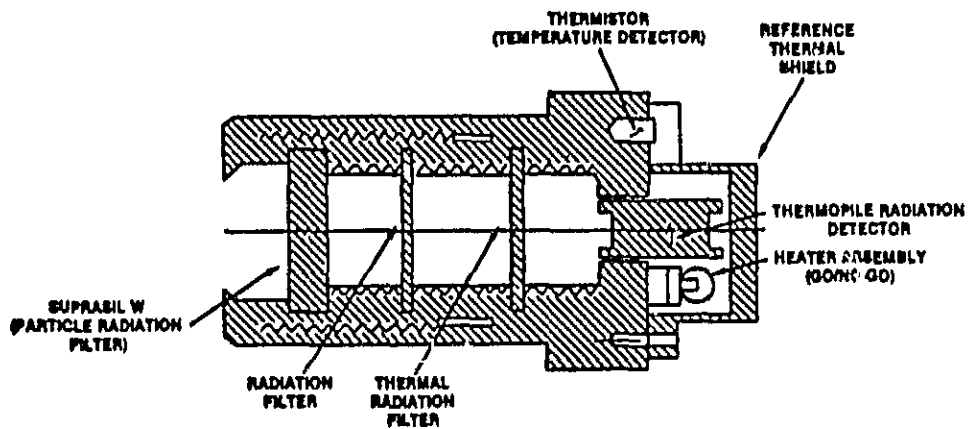


Figure 2-2: Typical Solar Channel Schematic (Jacobowitz, et. al., 1984)

to identify spectral regions of solar variability in the visible and near UV and to yield information on uncertainties in the present values of the solar emission spectrum.

### 2.3.1 Origin of ERB Solar Data

When the ERB instrument is on, measurement of the solar irradiance by the 10 solar channels are made once per orbit as the Nimbus-7 spacecraft crosses the southern terminator just before its northward movement over the sunlit side of the earth. The instrument views space as a reference before and after each solar exposure. The mission allows for up to 14 measurements per day at approximately 104 minute intervals. For the channel 10c cavity radiometer, the solar disk is completely within the cavity field of view (100°) for approximately 200 seconds during each 104 minute orbit. Therefore, a single orbit contains a solar record of 200 raw count samples which are digitized on an 11-bit quantization scale. A smoothed estimate of solar irradiance for each solar measurement, approximately 14 values per day, can be averaged to generate a best daily estimate of the solar constant (Hickey, et al., 1983).

### 2.3.2 ERB Solar Channel Calibration

#### Pre-launch

The reference for the pre-flight absolute calibration of the ERB solar channels was the World Radiometric Reference (WRR) scale which is embodied in a number of self-calibrating cavity radiometers. Solar channel 10c of the ERB is such a device. This new scale can be referenced to previous scales such as the International Pyrheliometric Scale (IPS 1956). The four major solar channels (1, 2, 3, and 10c) have been directly intercompared with self-calibrating cavity instruments of the JPL-PACKRAD and Eppley model H-F types.

For transfer operations, a solar simulator was used as a source and a normal incidence pyrheliometer (NIP) was employed, both traceable to the WRR. When calibrating the filtered channels (4, 5, 6, 7, 8, and 9) the NIP was fitted with a filter wheel containing filters matching the flight set. The incident irradiance is calculated using the measured irradiance and the appropriate filter factor for the particular filter.

The ERB Reference Sensor Model (RSM), which is a duplicate of the flight instruments relative to the solar channels, has been employed as a transfer and checking device throughout the Nimbus 6 and Nimbus 7 calibration program. All vacuum calibrations of the Nimbus 6 and 7 ERB solar channels could be referenced through the RSM as well as many of the calibrations performed at atmospheric pressure.

### In-flight

In-flight calibration for the solar channels does not exist, except for channel 10c whose cavity is heated by a precision resistance heater. Accurate monitoring of the voltage and current of the heater as well as the detector response yields the calibration sensitivity. This led to very precise determinations of the total solar irradiance (Hickey, et al., 1981). All thermopile channels are equipped with the same heaters which are used during pre-launch activities to check whether the channels are functioning properly. The heaters are used as a rough check in the analysis of operational data. These channels are also equipped with an electrical calibration which inserts a precision voltage staircase at the input to the entire signal conditioning stream. While the electronic calibration cannot be used to infer changes in the sensor or optics characteristics, it insures the prevention of misinterpretation of electronic measurements. Analysis of the electronic calibration data has yielded no abnormalities. Channels 1 through 3 can be directly compared with channel 10c to assess their in-flight calibration. In addition, the degradation of channel 2 is checked by the occasional exposure of its duplicate (channel 1), which is normally shuttered.

The degradation with time of the solar channels 1 through 9 is depicted in Figure 2-3 for the first 8 months of flight. Particular attention should be given to channels 6 through 9 which contain the interference filters. Their curves show that a high rate of degradation occurred during the first two months followed by a short period of relative stability. After this the channels reversed the earlier trend and began to recover. After a little over four months in orbit, three of the channels completely recovered while the remaining one (channel 7) almost recovered.



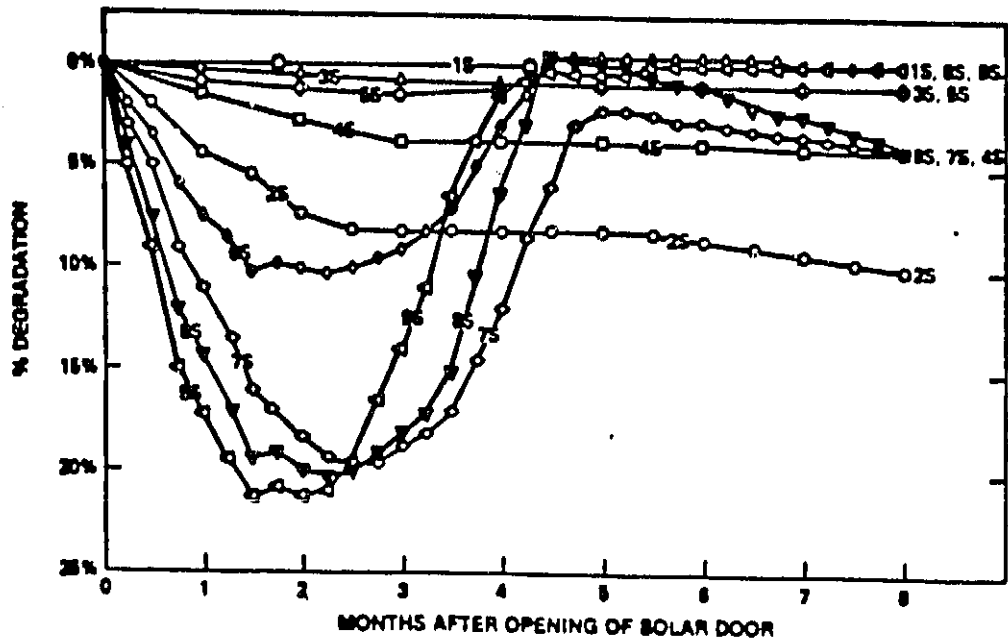


Figure 2-3: Percent Degradations Of Solar Channels.  
 (Jacobowitz, et al., 1984).

### 2.3.3 ERB Solar Data for SEFDT

Initially only a preliminary data set of the total solar irradiance called the 'engineering level' data was available. Other solar parameters were obtained from the ERB Master Archival Tapes (MATS). After preliminary review of the processed flight data from the Nimbus-7 ERB, certain changes were made in the processing algorithms and the solar data was reprocessed. This new high-quality data set for the ERB solar channels (plus earth flux channel data) were made available on a set of special digital tapes referred to as the Solar-Earth Flux Data Tapes (SEFDT). A user's guide for the SEFDT data has recently been made available (Ray, et al., 1984).

#### 2.3.3.1 ERB Solar Channel Algorithms

The algorithms used to determine the solar irradiance from the 10 ERB solar channels are as follows (Ray, et al., 1984):

The Temperature Sensitivity Correction Factor

$$S(T) = S_V (1 + A (T - L)) \quad (1)$$

where

- $S_V$  = Channel sensitivity in a vacuum at 25° C (22° C for channel 10c only) in counts per watts/m<sup>2</sup> (see Table 2-1).  
 $A$  = Temperature sensitivity at 25° C (22° C for channel 10c only) in °C<sup>-1</sup> (see Table 2-1)  
 $T$  = Temperature in °C.  
 $L$  = Reference Temperature:  
Channels 1-9: 25° C  
Channels 10c: 22°

The uncorrected Net Solar Irradiance:

$$R = \left[ V_0 - \frac{1}{2} (V_- + V_+) \right] / S(T) \quad (2)$$

TABLE 2-1

CHANNEL COEFFICIENTS

CHANNEL	S <sub>v</sub>	A
1	1.299	0.0007
2	1.275	0.0008
3	1.214	0.0008
4	1.719	0.0007
5	2.424	0.0006
6	6.931	0.0007
7	9.588	0.0003
8	12.715	-0.0004
9	30.170	-0.0011
10c	1.3013	0.000524

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where

- $V_0$  = Solar channel detector output in counts at  $T_0$
- $V_-$  = Solar channel detector output in counts at  $T_0 - 13$  minutes
- $V_+$  = Solar channel detector output in counts at  $T_0 + 13$  minutes
- $S(T)$  = Temperature sensitivity correction factor

For the ERB channel 10C, a self-calibrating cavity thermopile for equations used to convert counts to irradiance are:

$$H_{10C} = E_m C_f / S_p(T) \quad (2)$$

Where

$$E_m = E_{OS} - \frac{E(-13) + E(+13)}{2} \quad (3)$$

$$S_p(T) = S_0 + S (T_H - 22^\circ) \quad (4)$$

- $H_{10C}$  = channel 10C irradiance in  $W/m^2$
- $C_f$  = channel 10C correction factor for aperture area and nonequivalence ( $M^{-2}$ )
- $E_{OS}$  = average channel 10C on-sun counts
- $E(\pm 13)$  = average channel 10C counts at  $\pm 13$  minutes from on-sun time
- $S_0$  = power sensitivity zero level (C/W)
- $S_p$  = power sensitivity slope (C/W $^\circ$ C)
- $T_H$  = channel 10C heat sink temperature ( $^\circ$ C)

**Adjustment of Channel 10c for Reflectance.**

(Note: This correction is applied to Channel 10c only).

$$R_{10c} = U_{10c} * 0.998$$

$U_{10c}$  = Unadjusted Channel 10c Net Solar Irradiance

$R_{10c}$  = Adjusted Channel 10c Net Solar Irradiance

Note: At this point, all the net solar irradiances must be corrected for Sun-Earth distance.

**Correction of Net Solar Irradiance for Sun-Earth Distance.**

$$NSR = R * R_{SE}^2 \tag{6}$$

$R$  - Uncorrected Net Solar Irradiance

$R_{SE}$  - Instantaneous Sun-Earth Distance in Astronomical units. Note that the average Sun-Earth distance in astronomical units is 1.0.

NSR is the final corrected Net Solar Irradiance that appears in the SEFDT Solar Orbital Summary Records.

This is the value for the irradiance that also appears in the orbital and daily mean files of the ESAT.

In addition a separate cosine-corrected channel 10c value is given in the ESAT orbital and daily mean files. This is a correction for the off-axis angle ( $\gamma_{off-axis}$ ). The off-axis angle measures the angular deviation of the pointing vector of the solar channel assembly from the position of the Sun. The gamma angle  $\gamma$  is adjusted by ground commands in order to account for changes in the DSAS (solar azimuth) angle. The off-axis angle as used in the SEFDT is defined as (Ray, et al., 1984):

$$\gamma_{off-axis} = \gamma + 0.1 * \beta_{DSAS}$$

This angle is then used by the Eppley Laboratories to obtain the cosine-corrected channel 10c irradiance:

$$NSR^*(10c) = NSR(10c)/\cos (\gamma_{\text{off-axis}})$$

### 2.3.3.2 Time of Minimum Solar Elevation

The time of minimum solar elevation is defined to be the relative minimum of the ERB solar channel 5 counts for each orbit as shown in figure 2-4. Channel 5 is the solar alignment indicator because it suffers the least degradation of those channels (1, 2, 4 and 5) that have the proper angular response function.

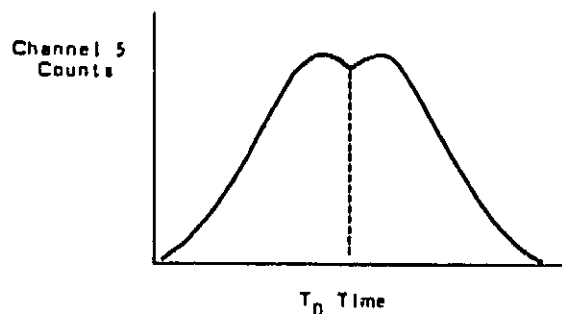


Figure 2-4. Time of minimum solar elevation

The time of minimum solar elevation was labelled  $T_0$  for all of the ten solar channels.

The algorithm for determining  $T_0$  was a 3-step process:

- 1) Search the Channel 5 counts for the orbit and tabulate the occurrence of counts between 1000 and 2000. Counts greater than 1000 indicate sun is in the field of view.
- 2) Find, in the table, the smallest count value occurring more than four times (occurring  $n$  times).
- 3)  $T_0$  is the time associated with the median of the possible smallest count values ( $n/2$ ). (i.e., if the smallest count values occurs 8 times,  $T_0$  will be the time associated with the fourth occurrence).

If no time of minimum solar elevation was found,  $T_0$  was set to the southern terminator time for selection of solar data records.

## 2.4 Solar Activity Indicators

The ERB solar channels are well designed to measure fluctuations in the solar irradiance at several spectral bands. Preliminary studies of variations in solar radiance with channel 10c have shown that sensor to be quite stable and well behaved over the first year of measurement (Hickey, et al., 1980). Over longer periods (first 3 ERB years), measurements of the solar irradiance have revealed a downward trend which may be due to actual solar irradiance variability rather than instrumental degradations (Hickey, et al., 1983; Smith, et al., 1983a).

It has been theorized that solar activity (indicated by sunspots, plage regions, etc.) may cause changes in the solar irradiance (Foukal, et al., 1977). The high quality ERB solar measurements constitute a time series that can be matched with solar activity indicators. Preliminary correlative analysis with solar activity indicators (sunspot numbers and 2800 MHz solar flux) seem to match dip in ERB solar irradiance measurement with peak in solar activity as shown in Figure 2-5 for the five-year channel 10c data. This has been discussed by Hickey et al., (1982), Hickey and Alton (1983) and Smith et al., 1983a,b). Data from the SEFDT was used to construct this figure. Other studies with a similar cavity radiometer (ACRIM) on the Solar Maximum Mission (SMM) show similar correlations (Willson, et al., 1981). The nature of these variations in the solar irradiance is reasoned to be attributed to the equatorial solar rotation cycle, a long-term (11-year) solar cycle and a long-term solar cycle not directly related to solar activity (Smith, et al., 1983).

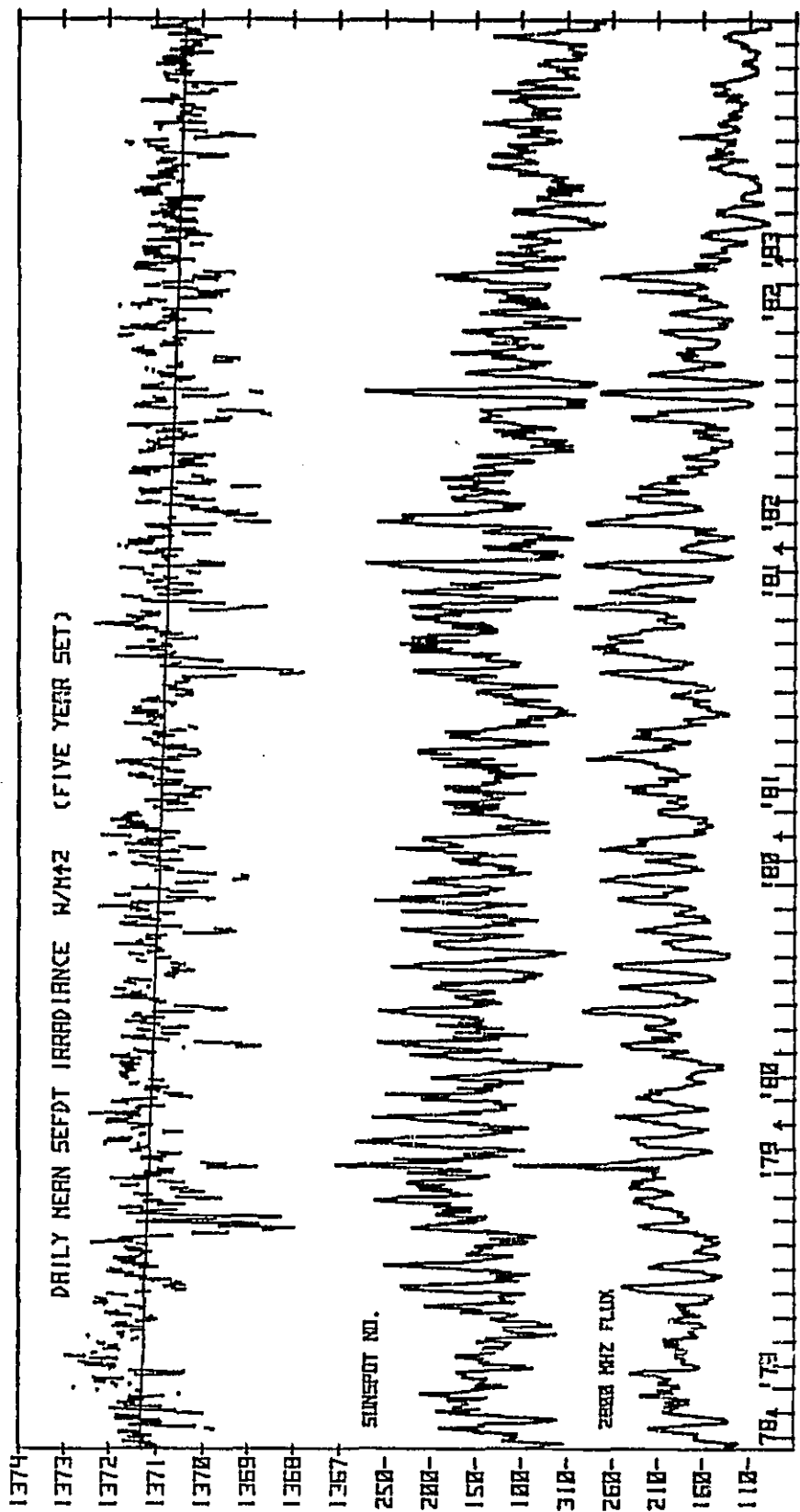


Figure 2-5: Channel 10C Irradiance vs. Solar Activity Indicators.  
 (Hickey, J.R., Eppley Labs, 1984)



### 3.0 DESCRIPTION OF ESAT CONTENTS

#### 3.1 Origin of ESAT Data

A complete and high precision data set for the Nimbus-7 ERB solar channels was made available on a set of special digital tapes referred to as the Solar-Earth Flux Data Tapes (SEFDT). The ERB solar data on these tapes were used by Eppley Labs to derive the solar data for the ESAT. Appendix B shows the SEFDT tapes used to generate the ESAT data. With the exception of channel 10c (see section 3.3), all of the ERB solar channel data on the ESAT are the same as on the SEFDT.

#### 3.2 Differences between ESAT and SEFDT

The purpose of ESAT was to have a complete ERB solar data set free of the Earth-flux data and other information on the SEFDT that is not used by the solar community. Although the solar data used to generate the ESAT data set was derived from the SEFDTs, there are some differences between the two data sets.

- o Solar data corrected or deleted for bad orbits and/or missing or incorrect data (see section 3.3)
- o Daily mean and statistics derived from 'cleaned' orbital information are included on the ESAT.
- o Calculated off-axis angle, mission day and earth-sun distance are included on ESAT.
- o Cosine-corrected channel 10c (see section 3.3) included on ESAT.
- o ESAT includes solar activity indicators.

#### 3.3 Corrections to SEFDT Data

The solar data for the ESAT represents a higher order data set than the already high quality SEFDT data. For the ESAT data set, orbits and/or variables that are incorrect or beyond certain limits were deleted or corrected by Eppley Laboratories from the SEFDT orbital summary records. Limit criteria were based on the off-axis angle and temperatures

of channels 3 and 10c. If the off-axis angle exceeded  $3.1^\circ$  then those orbits were deleted. If the temperature of either channel 3 or channel 10c fell below  $18^\circ\text{C}$  then those orbits were deleted. The daily mean solar data and statistics were generated after screening of the orbital data.

The ESAT data set includes a cosine-corrected channel 10c. This correction is a first-order correction performed by Eppley Labs and is simply the cosine of the off-axis angle applied to the mean channel 10c irradiance calculated in the SEFDT.

The ESAT data set also includes the calculated mission day (Mission day 1 is Nov. 16, 1978) and the calculated off-axis angle (solar azimuth + gamma angle).

#### 3.4 Origin of Solar Activity Indicators

The solar activity indicators defined on the ESAT were derived from the NOAA/National Geophysical Data Center (NGDC) Solar Geophysical Data Reports (SGD) (NOAA/NGDC, 1982). Sunspot and solar flux data, initially derived from the SGD's were obtained from Eppley Labs. Solar plage data were obtained from Dr. Ken Schatten at NASA/GSFC and were originally obtained from NOAA/NGDC World Data Center-A and published in the SGD. Daily calcium plage index and geomagnetic index were obtained directly from the SGD prompt reports.

A detailed description of the solar activity indicators are as follows:

Zurich Relative Sunspot Numbers. A measure of visible daily solar activity. This number is derived from several observatories and combines the number of single spots and groups of spots on the solar disk. The formula is:

$$R_z = k(10g + s)$$

Where

- 10g = number of spots and groups (weighted by 10)
- s = total number of distinct single parts
- k = factor that depends on the observer and is used to convert measure from the original Wolf sunspot scale.

The Zurich Relative Sunspot Numbers comprise a complete daily record of solar activity for the five year period from 16 November 1978 through 31 October 1983.

Ottawa 2800 MHz Solar Flux. A measure of daily radio solar activity. These measurements are the daily observations of the 2800 MHz radio emissions that originate from the solar disk and from any active region. Measurements are made at the Algonquin Radio Observatory (ARO) of the National Research Council of Canada with a 1.8 m diameter reflector. Measurements are in flux units of  $10^{-22} \text{Wm}^{-2}\text{Hz}^{-1}$ .

The Ottawa 2800 MHz Solar Flux comprise a complete daily record of solar activity for the five year period from 16 November 1978 through 31 October 1983.

Daily Calcium Plage Index. An index of solar activity based on the solar plage area and coordinates. The index as given by W. R. Swartz and modified in the SGD is:

$$C_{AII}^{\text{index}} = \left[ \sum_i I_i A_i \cos \theta_i \cos \phi_i \right]$$

where the summation includes all plages visible on that day,

- $I_i$  = intensity of plage i
- $A_i$  = corrected area of plage i in millionths of solar hemisphere
- $\theta_i$  = central meridian distance of plage i in degrees
- $\phi_i$  = latitude of plage i

The Daily Calcium Plage Index data is available on a daily basis from 16 November 1978 through August 1982. Missing data or where no observations were made are defined as 0.

Geomagnetic Index. A daily index of magnetic activity due to solar events recorded on a linear scale. The daily Ap series is used and is an average of 8 values of an intermediate 3-hourly index.

The Geomagnetic Ap Series Index is available on a daily basis from 16 November 1978 through December 1982. Missing data are defined as 0.

Solar Plage Data. Plage regions are the bright areas on the solar disk (also called faculae) sometimes preceding the appearance of spots. Seven parameters describe the plage region. These were derived from the SGD:

McMath-Hale Region Number. This is the active region number assigned in order of appearance on the solar disk. More than one region number can appear on a day.

Central Meridian Passage Data. The date of central meridian passage of the region, at 12<sup>h</sup>UT and corrected for whether noon or after noon.

Latitude. The latitude of the region center of mass, north or south of solar equator. Negative latitudes are south.

Central Meridian Distance. Distance of the region center of mass east or west of the central meridian at 12<sup>h</sup>UT. Distance is in degrees measured to the West 0-360°.

Carrington Longitude. An internationally agreed zero meridian. This is the central meridian that passed through the apparent center of the disk on 1 January 1854 at 12<sup>h</sup>UT. The Carrington longitude is measured in degrees to the west 0-360°. The zero meridian is established on completion of a solar rotational period with mean duration of 27.2753 days.

Area. The corrected area (corrected for distance from the center of the solar disk) in millionths of the solar hemisphere.

Intensity. The intensity of the plage region on a scale of 1 (very faint) to 5 (very bright).

Solar plage data is available from 16 November 1978 through June 1982. The number of plage regions per day is noted on the ESAT tape in order to read the proper number of plage region records. If no observations were made then the solar plage parameters are 0.

### 3.5 ERB Solar Channel Data

The ERB solar channel data, derived from the SEFDTs, are comprised of two parts: the orbital solar data and the daily mean solar data which consists of the mean, standard deviation, minimum and maximum. The daily mean data was derived by Eppley Labs from the filtered orbital data using the Statistical Analysis System (SAS) software package.

The contents of the orbital ERB solar data is as follows:

- o Orbit number, year, day of year
- o Solar azimuth and elevation
- o Instrument status word (ISW)
- o Gamma angle
- o Earth-sun distance (Least Significant Bit, Most Significant Bit)
- o Channel 3 and Channel 10c temperatures
- o Channels 1-10c irradiances
- o Southern terminator crossing time
- o Mission day since Nov. 16, 1978
- o Off-axis angle
- o Cosine corrected channel 10c irradiance

The contents of the daily mean ERB solar data (which includes the mean, standard deviation, minimum and maximum and number of orbits of each parameter) is as follows:

- o Orbit number, year, day of year
- o Solar azimuth and elevation
- o Gamma angle
- o Channel 3 and 10c temperatures
- o Channel 1-10c irradiances
- o Mission day since Nov. 16, 1978
- o Off-axis angle
- o Cosine corrected channel 10c irradiance
- o Earth-Sun distance

### 3.6 Solar Activity Indicators

The solar activity indicators on the ESAT are not the most comprehensive but do constitute a long time series of the more common and useful indicators.

A description of the contents of the solar activity data set is as follows:

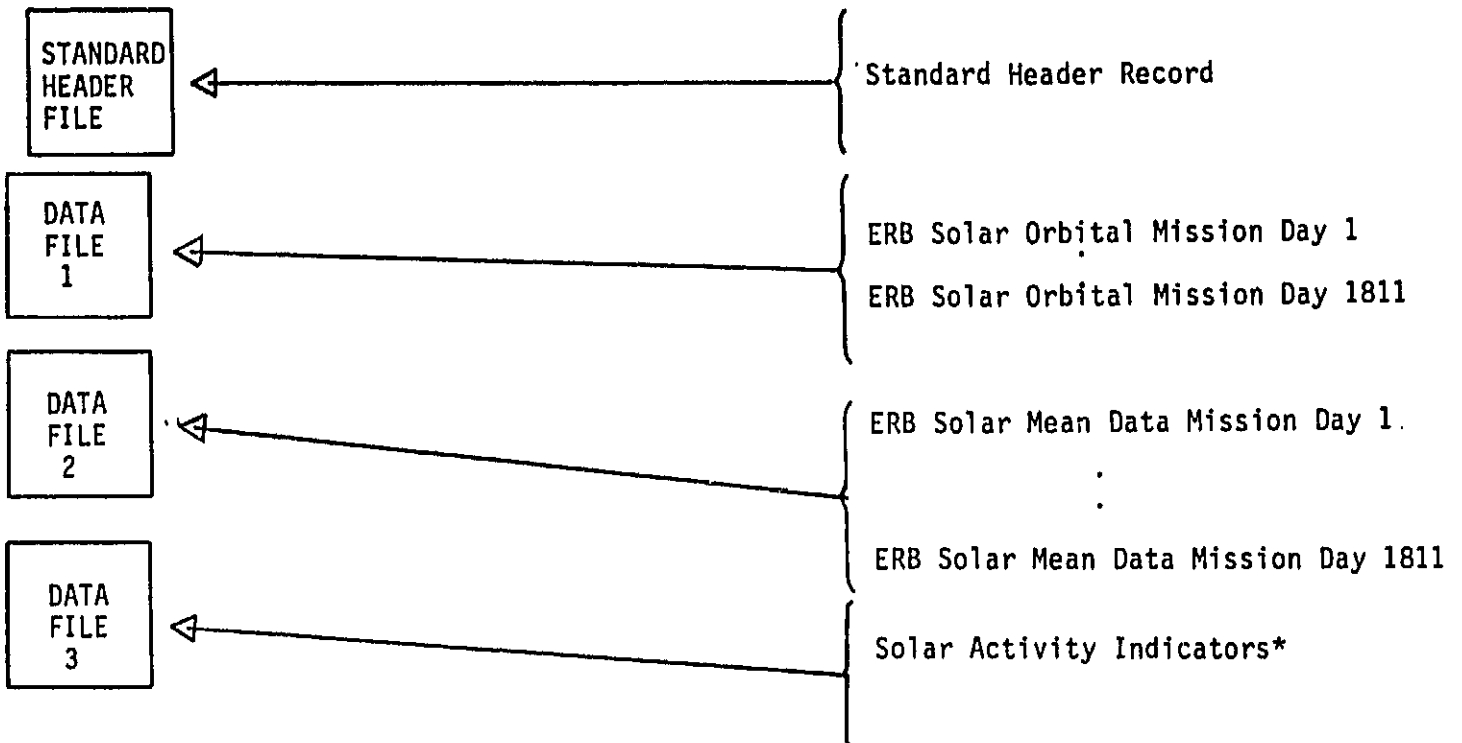
- o Zurich Relative Sunspot Number (daily)
- o Ottawa ARO 2800 MHz solar flux (daily)
- o Daily Calcium Plage Index
- o Geomagnetic Index (Ap)
- o Solar plage regions including:
  - o McMath-Hale region number
  - o coordinates including CM and Carrington longitude
  - o corrected area
  - o Intensity

### 3.7 Missing Data

Missing data in the orbital and mean datasets are flagged with -9999. Data gaps and ERB off days in the mean data are flagged with -9999. Gaps in the solar activity records are not flagged but are simply missing as indicated by 0.

### 3.8 ESAT Tape Structure

The ESAT has three data files. Data File 1 contains the five-year orbital data set, Data File 2 contains the daily mean five-year data set, and Data File 3 contains the solar activity data. The physical structure of the tape is shown in figure 3-1.



\*Not all solar activity indicators are available for all five years.

Figure 3-1: Physical Structure of ESAT Tape



## 4.0 PHYSICAL STRUCTURE OF ESAT TAPE

### 4.1 Tape Organization

The ESAT Tape is a 9-track, unlabeled, 1600 BPI IBM 370/3081 compatible tape. The first file contains the Nimbus Observation Processing System (NOPS) Standard Header. The second file contains the ERB solar orbital data for five years. The third file contains the ERB solar daily mean data for five years. The fourth file contains the solar activity indicator data.

The NOPS Standard Header file is described in Appendix A.

### 4.2 Tape and File Specifications

Tape Specifications: 1600 BPI, 9-track non-labeled tape

File Specifications:

	Header <u>File</u>	Data <u>File 1</u>	Data <u>File 2</u>	Data <u>File 3</u>
File Location	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Record Length (bytes)	630	84 <sup>1</sup>	376 <sup>2</sup>	56 <sup>3</sup>
Record Format	unblocked	U	U	U
Data Type	EBCDIC	binary	binary	binary
Rec ID No	none	100	200	300

<sup>1</sup>84 bytes per observations x 18466 observations = 1,551,144 bytes

<sup>2</sup>376 bytes per day x 1811 days = 680,936 bytes

<sup>3</sup>56 bytes per observation x 1811 days = 101,416 bytes minimum

The total number of bytes for the solar activity data set 729,036 bytes.

### 4.3 ESAT Data File Specifications

The following Tables (4.1, 4.2, and 4.3) and accompanying information describe in detail the word location of each data item in each data file. A description of each data item is also included. Appendix C includes the scale factors used to generate the ESAT data set.

TABLE 4-1  
ESAT ORBITAL DATA  
RECORD FORMAT

WORDS	MSB		LSB		BITS
	32		0		
1	RECORD NUMBER		RECORD ID		32
2	ORBIT NO.		SPARE		64
3	YEAR		DAY OF YEAR		96
4	SOLAR AZIMUTH		SOLAR ELEVATION		128
5	INSTRUMENT STATUS WORD		GAMMA ANGLE		160
6	EARTH-SUN DISTANCE (MSB)		EARTH-SUN DISTANCE (LSB)		192
7	CHANNEL 3 TEMPERATURE				224
8	CHANNEL 10 c TEMPERATURE				256
9 - 18	CHANNEL 1-10c IRRADIANCE				576
19	SOUTH TERM. (HRS/MIN)		SOUTH TERM. (SECS.)		608
20	MISSION DAY		OFF-AXIS ANGLE		640
21	COSINE-CORRECTED CHANNEL 10c IRRADIANCES				672

WORDS 1-6 AND 19-20 ARE IBM INTEGER\*2 FORMAT  
WORDS 7-8 AND 21 ARE IBM INTEGER\*4 FORMAT

TABLE 4-2

ESAT DAILY MEAN DATA  
RECORD FORMAT

WORDS	MSB	LSB	BITS
	32	0	
1	RECORD NUMBER	RECORD ID	32
2 - 6	ORBIT NO. (MEAN, STD. DEV., MIN., MAX., NO)		192
7	YEAR		224
8	DAY OF YEAR		256
9 - 13	SOLAR AZIMUTH (MEAN, STD. DEV., MIN., MAX., NO.)		416
14 - 18	SOLAR ELEVATION (MEAN, STD. DEV., MIN., MAX., NO.)		576
19 - 23	GAMMA ANGLE (MEAN, STD. DEV., MIN., MAX., NO.)		736
24 - 28	CHANNEL 3 TEMPERATURE (MEAN, STD. DEV., MIN., MAX., NO.)		896
29 - 33	CHANNEL 10c TEMPERATURE (MEAN, STD. DEV., MIN., MAX., NO.)		1056
34 - 83	CHANNEL 1-10c IRRADIANCE (MEAN, STD. DEV., MIN., MAX., NO.)		2656
84	MISSION DAY		2688
85 - 89	OFF-AXIS ANGLE (MEAN, STD. DEV., MIN., MAX., NO.)		2848
90 - 94	COSINE-CORRECTED CHANNEL 10c IRRADIANCE (MEAN, STD. DEV., MIN., MAX., NO.)		3008

WORD 1 IS IBM INTEGER\*2 FORMAT  
WORDS 2-99 ARE IBM INTEGER\*4 FORMAT

TABLE 4-3

ESAT SOLAR ACTIVITY DATA  
RECORD FORMAT

WORDS	MSB	LSB	BITS
1	32	0	32
	RECORD NO.	RECORD ID.	
2			64
	YEAR	DAY OF YEAR	
3			96
	NUMBER OF PLAGE OBSERVATIONS		
4			128
	ZURICH SUNSPOT NUMBER		
5			160
	2800 MHz SOLAR FLUX		
6			192
	DAILY CALCIUM PLAGE INDEX		
7			224
	GEOMAGNETIC INDEX, A <sub>p</sub> SERIES		
8 - 14			448*
	SOLAR PLAGE REGION DATA		

WORDS 1-2 ARE IBM INTEGER\*2 FORMAT  
WORDS 3-14 ARE IBM INTEGER\*4 FORMAT

\*MINIMUM OF 448 BITS, DEPENDS ON NUMBER OF PLAGE REGIONS PER DAY.

ERB SOLAR ANALYSIS TAPE - DATA FILE 1  
ORBITAL ITEM DESCRIPTIONS

<u>ITEM NO.</u>	<u>WORD</u>	<u>TYPE</u>	<u>DETAILED DESCRIPTION OF DATA ITEMS</u>
1	1	I*2	RECORD NO. - Number of this record in this file.
2	1	I*2	RECORD ID. - Record identification number. 100 = Orbital File
3	2	I*2	ORBIT NO. - Data orbit number
4	2	-	Spare (-9999)
4	3	I*2	YEAR - 4 digit year
5	3	I*2	DAY OF YEAR - Day number
6	4	I*2	SOLAR AZIMUTH - Azimuth of sun relative to the S/C axes. Value in degrees (-180 to +180). Same as DSAS alpha angle, scaled by 10.
7	4	I*2	SOLAR ELEVATION - Elevation of sun relative to the S/C axes. Value in degrees (-180 to +180). Same as DSAS beta angle, scaled by 10.
8	5	I*2	INSTRUMENT STATUS WORD - Determined from VIP MF.

Units Decimal Digit (indicates position of scanhead)

0 = Scan mode	3 = LW check position
1 = Nadir position	4 = SW check position
2 = Space position	9 = Transition mode

Tens Decimal Digit (indicates status of shutters, chs. 1, 11, & 12)

0 = Reference chs. CLOSED, Ch. 12 OPEN
1 = Reference chs. CLOSED, Ch. 12 CLOSED
2 = Reference chs. OPEN, Ch. 12 OPEN
3 = Reference chs. OPEN, Ch. 12 CLOSED
9 = Status unknown

Hundreds Decimal Digit (indicates status of Ch. 12 FOV)

0 = Ch. 12 FOV Wide
1 = Ch. 12 FOV narrow
9 = Status Unknown

<u>ITEM NO.</u>	<u>WORD</u>	<u>TYPE</u>	<u>DETAILED DESCRIPTION OF DATA ITEMS</u> <u>Thousands Decimal Digit (indicates status of El. Cal., and Go/No go heater)</u>
			0 = Go/No go heater OFF, El. Cal. OFF 1 = Go/No go heater OFF, El. Cal. ON 2 = Go/No go heater ON, El. Cal. OFF 9 = Status unknown
9	5	I*2	GAMMA ANGLE - Solar channel subassembly position at Middle of MF.
10	6	I*2	EARTH-SUN DISTANCE - MSB Earth-Sun distance.
11	6	I*2	EARTH-SUN DISTANCE - LSB Earth-Sun distance.
12	7	I*4	CHANNEL 3 TEMPERATURE - Temperature in degrees centigrade, scaled by 10.
13	8	I*4	CHANNEL 10c TEMPERATURE - Temperature in degrees centigrade, scaled by 10.
14-24	9-18	I*4	CHANNEL 1-10c IRRADIANCES - Channels 1-10c irradiances in W/m <sup>2</sup> . Scale factor for channels 1-5, 10c is 10; channels 6-9 is 100.
25	19	I*2	SOUTHERN TERMINATOR (HRS/MIN) - GMT hours/minutes of southern terminator crossing.
26	19	I*2	SOUTHERN TERMINATOR (SECS) - GMT seconds of southern terminator crossing.
27	20	I*2	MISSION DAY - Mission day number starting with 1 on 16 November 1978.
28	20	I*2	OFF-AXIS ANGLE - Calculated sum of solar azimuth and gamma angles.
29	21	I*4	COSINE-CORRECTED CHANNEL 10c - channel 10c irradiance corrected with cosine of off-axis angle, scaled by 10.

ERB SOLAR ANALYSIS TAPE  
ERB DAILY MEAN ITEM DESCRIPTIONS - DATA FILE 2

<u>ITEM NO.</u>	<u>WORD</u>	<u>TYPE</u>	<u>DETAILED DESCRIPTION OF DATA ITEMS</u>
1	1	I*2	RECORD NUMBER - The number of this record in this file.
2	1	I*2	RECORD ID - The record identification for this file. 200 = Daily Mean
3	2-6	I*4	ORBIT NUMBER - Data Orbit number Mean - scaled by 1000 Std. Dev. - scaled by 100,000 MINIMUM - minimum orbit number MAXIMUM - maximum orbit number NUMBER - Number of orbits to calculate mean
4	7	I*4	YEAR - 4-digit year.
5	8	I*4	DAY OF YEAR - Day number
6	9-13	I*4	SOLAR AZIMUTH - Azimuth of sun relative to S/C axes. Value in degrees (-180 to +180). MEAN - scaled by 10,000 Std. Dev. - scaled by 1,000,000 MINIMUM - Minimum solar Azimuth, scaled by 10. MAXIMUM - Maximum solar azimuth, scaled by 10 NUMBER - Number to calculate mean
7	14-18	I*4	SOLAR ELEVATION - Elevation of sun relative to S/C axes. Value in degrees (-180 to +180). MEAN - scaled by 10,000 STD. DEV. - scaled 100,000 MINIMUM - minimum solar elevation, scaled by 10. MAXIMUM - Maximum solar elevation, scaled by 10. NUMBER - Number to calculate mean.
8	19-23	I*4	GAMMA ANGLE - Solar channel subassembly position at middle of MF. MEAN - scaled by 100,000 STD. DEV. - scaled by 100,000 MINIMUM - minimum gamma angle MAXIMUM - maximum gamma angle NUMBER - number to calculate mean gamma angle

<u>ITEM NO.</u>	<u>WORD</u>	<u>TYPE</u>	<u>DETAILED DESCRIPTION OF DATA ITEMS</u>
9	24-28	I*4	<p><b>CHANNEL 3 TEMPERATURE</b> - Temperature of channel 3 in degrees centigrade.  <b>MEAN</b> - scaled by 10,000  <b>STD. DEV.</b> - scaled by 100,000  <b>MINIMUM</b> - minimum channel 3 temperature, scaled by 10.  <b>MAXIMUM</b> - Maximum channel 3 temperature, scaled by 10.  <b>NUMBER</b> - Number to calculate mean channel 3 temperature</p>
10	29-33	I*4	<p><b>CHANNEL 10c TEMPERATURE</b> - Temperature of channel 10c in degrees centigrade.  <b>MEAN</b> - scaled by 10,000  <b>STD. DEV.</b> - scaled by 100,000  <b>MINIMUM</b> - Minimum channel 10c temperature, scaled by 10.  <b>MAXIMUM</b> - Maximum channel 10c temperature, scaled by 10.  <b>Number</b> - Number to calculate mean channel 10c temperature.</p>
11	34-83	I*4	<p><b>IRRADIANCES</b> - channels 1-10c irradiances in W/m<sup>2</sup>.  <b>MEAN</b> - channel 1 scaled by 10; channels 2-3, 10c scaled by 100; channels 4-9 scaled by 1000.  <b>STD. DEV.</b> - channels 1-2, 4-6 scaled by 100,000. channels 3, 7-10c scaled by 1,000,000.  <b>MINIMUM</b> - minimum channels 1-10c irradiances. Channels 1-5 scaled by 10; channels 6-10c scaled by 100.  <b>MAXIMUM</b> - Maximum channels 1-10c irradiances. Channels 1-5, 10c scaled by 10; channels 6-9 scaled by 100.  <b>NUMBER</b> - Number to calculate mean channels 1-10c irradiances.</p>
12	84	I*4	<p><b>MISSION DAY</b> - Day number starting with 1 on 16 November 1978.</p>
13	85-89	I*4	<p><b>OFF-AXIS ANGLE</b> - calculated sum of solar azimuth and gamma angle.  <b>MEAN</b> - scaled by 10,000  <b>STD. DEV.</b> - scaled by 100,000  <b>MINIMUM</b> - minimum off-axis angle, scaled by 10.  <b>MAXIMUM</b> - Maximum off-axis angle, scaled by 10.  <b>NUMBER</b> - number to calculate mean off-axis angle.</p>



<u>ITEM NO.</u>	<u>WORD</u>	<u>TYPE</u>	<u>DETAILED DESCRIPTION OF DATA ITEMS</u>
14	90-94	1#4	<p><b>COSINE-CORRECTED CHANNEL 10c - Channel 10c irradiance corrected by cosine of off-axis angle.</b></p> <p><b>MEAN - scaled by 100</b></p> <p><b>STD. DEV. - scaled by 100,000</b></p> <p><b>MINIMUM - minimum corrected channel 10c irradiance</b></p> <p><b>MAXIMUM - maximum corrected channel 10c irradiance</b></p> <p><b>NUMBER - Number to calculate mean corrected channel 10c irradiance.</b></p>

ERB SOLAR ANALYSIS TAPE  
SOLAR ACTIVITY INDICATORS - DATA FILE 3

<u>ITEM NO.</u>	<u>WORD</u>	<u>TYPE</u>	<u>DETAILED DESCRIPTION OF DATA ITEMS</u>
1	1	I*2	RECORD NO. - the number of this record in this file.
2	1	I*2	RECORD ID - the record identification of this file. Solar Activity = 300.
3	2	I*2	YEAR - 4 digit year
4	2	I*2	DAY OF YEAR - Day number
5	3	I*4	PLAGE NO. - Number of plage regions for this day. If 0 then no observations are available for this day.
6	4	I*4	ZURICH RELATIVE SUNSPOT NUMBERS - daily index of solar activity. Daily sunspot numbers.
7	5	I*4	OTTAWA 2800 MHz SOLAR FLUX - daily index of solar activity. Daily radio emissions from active regions in $10^{-22} \text{Wm}^{-2} \text{Hz}^{-1}$ scaled by 10.
8	6	I*4	DAILY CALCIUM PLAGE INDEX - summation of all plages visible on solar disk corrected for distance from center.
9	7	I*4	GEOMAGNETIC INDEX - Geomagnetic Ap series measure of magnetic activity due to solar activity. Scaled by 10.
10	8-14	I*4	SOLAR PLAGE REGION DATA - consists of following seven parameters. MCMATH-HALE REGION NUMBER - number assigned to region of solar activity. CENTRAL MERIDIAN PASSAGE DATE - Central meridian at 12 <sup>h</sup> UT at time of observation. Scaled by 10. LATITUDE - Latitude of region north or south of solar equator. South latitudes are negative. CENTRAL MERIDIAN DISTANCE - distance east or west of central meridian of region. Measured 0-360° to the west. CARRINGTON LONGITUDE - central meridian that passed through solar disk on 1 January 1854 at 12 <sup>h</sup> UT. Measured 0-360° to the west. AREA - area of region corrected for distance from the center of the solar disk in millionths of solar hemisphere. INTENSITY - Intensity of region on a scale of 1 = faint to 5 = very bright, scaled by 10. <u>Note:</u> More than one solar plage region per day may be visible.

DAILY MEAN SOLAR IRRADIANCES

The daily mean solar irradiances as measured by each of the 10 ERB solar channels were plotted for the five years from 16 Nov 1978 through 31 Oct 1983 including data gaps as shown in figures 5-1 to 5-10.

No correction has been made in this data set for sensor degradation. Only channel 10c is self-calibrating and the calibration data shows no visible sign of degradation in this channel. Comparison of the 9 other solar channels to channel 10c shows a visible history of channel sensitivity changes in all 9 channels. This makes the analysis of this data more complicated than that of channel 10c. Hickey et al., (1981) and Smith et al., (1983a) have used the spectral channels to examine spectral irradiance changes connected to the solar rotation period during active sun periods. Additional studies of ERB spectral irradiances are planned by the ERB experiment team.

As discussed in Section 2.3.1, all of the channels except channel 10c were affected by degradation and recovery events immediately after launch. The ultraviolet channels, (6-9) were the most severely affected and show significant recovery, although channels 6 and 9 show a trend toward increasing solar irradiance. This degradation and recovery process was explained in a paper by Predmore, et al., (1982). The plots shown in Figures 5-1 through 5-10 show ERB solar channel measurements that were screened for bad orbits, etc. from the SEFDTs as discussed in Section 3.3. The following preliminary analysis describes the degradation and recovery characteristics of each channel:

Channel 1: Mostly shuttered and opened periodically, but does show a constant downward trend. After initial degradation and recovery, Channel 1 shows 3% (0.6% per year) degradation from 1 Mar 1979 through 31 Oct 1983.

Channel 2: Initial degradation from 16 Nov 1978 through 30 Nov 1979. Channel 2 shows ~5.2% degradation (~1.3% per year) from 1 Dec 1979 through 31 Oct 1983.

Channel 3: Initial degradation from 16 Nov 1978 through 30 Apr 1979. Channel 3 shows an overall degradation 0.36% ( $\sim 0.08\%$  per year) from 1 May 1979 through 31 Oct 1983. However, there is a period of increasing irradiance from 31 Dec 1982 through 31 Oct 1983 of 0.3%. Therefore, the degradation from 1 May 1979 through 31 Dec 1982 is 0.7% ( $\sim 0.18\%$  per year).

Channel 4: Initial degradation from 16 Nov 1978 through 30 Nov 1979. Channel 4 shows  $\sim 3\%$  degradation ( $\sim 0.7\%$  per year) from 1 Dec 1979 through 31 Oct 1983.

Channel 5: Shows a complicated behavior throughout the five year period. Initial rapid degradation from 16 Nov 1978 to mid-January 1979 followed by recovery by early May 1979 and another degradation period to mid-August 1979. Channel 5 shows a recovery by 1 Dec 1979 and an overall degradation to 31 Oct 1983 of  $\sim 1.3\%$  ( $\sim 0.3\%$  per year). There is a period between 1 Jan 1981 and 1 Feb 1981 of very rapid drop in irradiance of  $\sim 1.2\%$  in 1 month.

Channel 6: Initial rapid degradation and recovery from 16 Nov 1978 through 31 Mar 1979. Channel 6 shows  $\sim 1.4\%$  increase in irradiance ( $\sim 0.3\%$  per year) from 1 Apr 1979 through 31 Oct 1983.

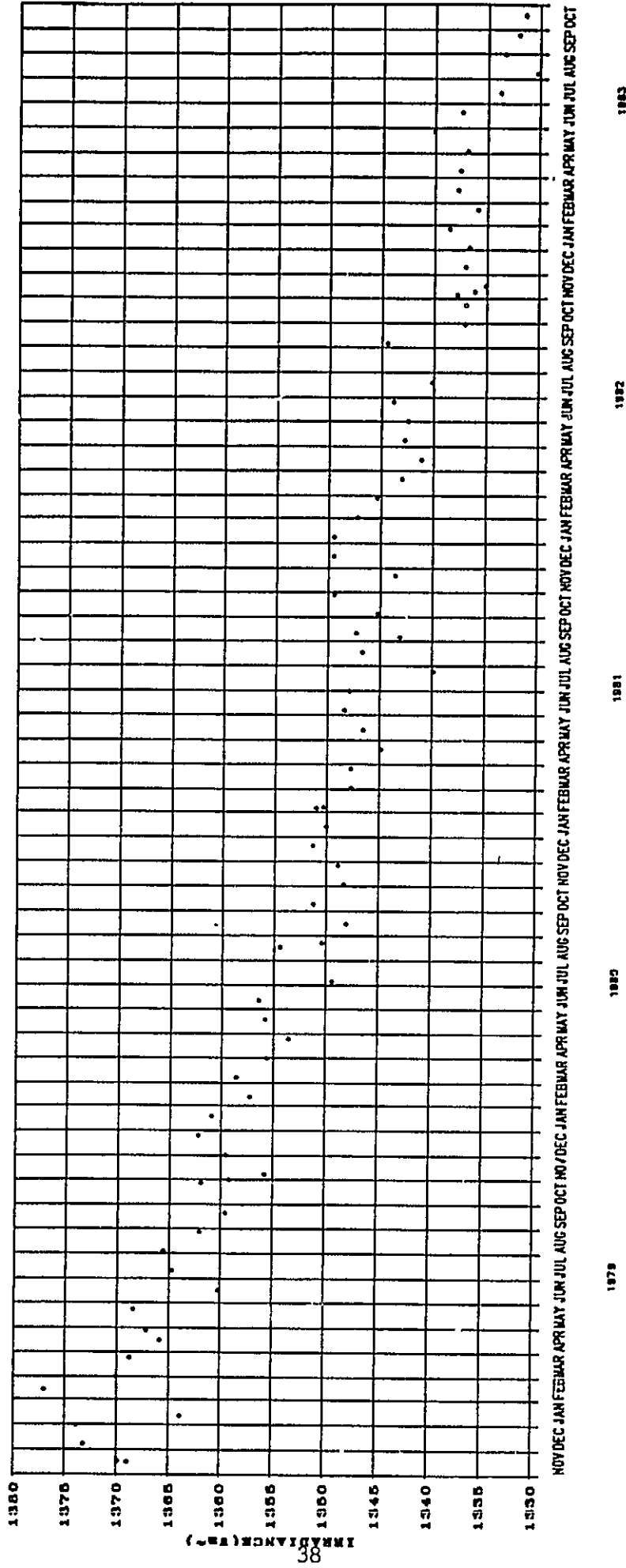
Channel 7: Initial rapid degradation and recovery from 16 Nov 1978 through 31 Mar 1979. Channel 7 shows a more marked degradation of  $\sim 18.5\%$  ( $\sim 4.1\%$  per year) from 1 Apr 1979 through 31 Oct 1973.

Channel 8: Initial rapid degradation and recovery from 16 Nov 1978 through 31 May 1979. Channel 8 shows  $\sim 30.3\%$  degradation ( $\sim 6.7\%$  per year) from 1 Apr 1979 through 31 Oct 1983.

Channel 9: Initial rapid degradation and recovery from 16 Nov 1978 through 31 Mar 1979. Channel 9 shows an increase in irradiance of  $\sim 6.4\%$  ( $\sim 1.4\%$  per year) from 1 Apr 1979 through 31 Oct 1983. There is a gap from mid-December 1982 through January 1983 where no data is available due to saturation of channel 9.

Channel 10c: Is a self calibrating cavity radiometer and the calibration data show no indication of degradation. It is therefore, hypothesized that the slight decrease in the solar constant from Nov. 1978 to Oct. 1983 may be real, however undetected degradation may exist. As discussed in Sec. 2.4 the short term excursions in the data correlate well with several solar activity indices.

RINGS 7 CH. 7 IRRADIANCE



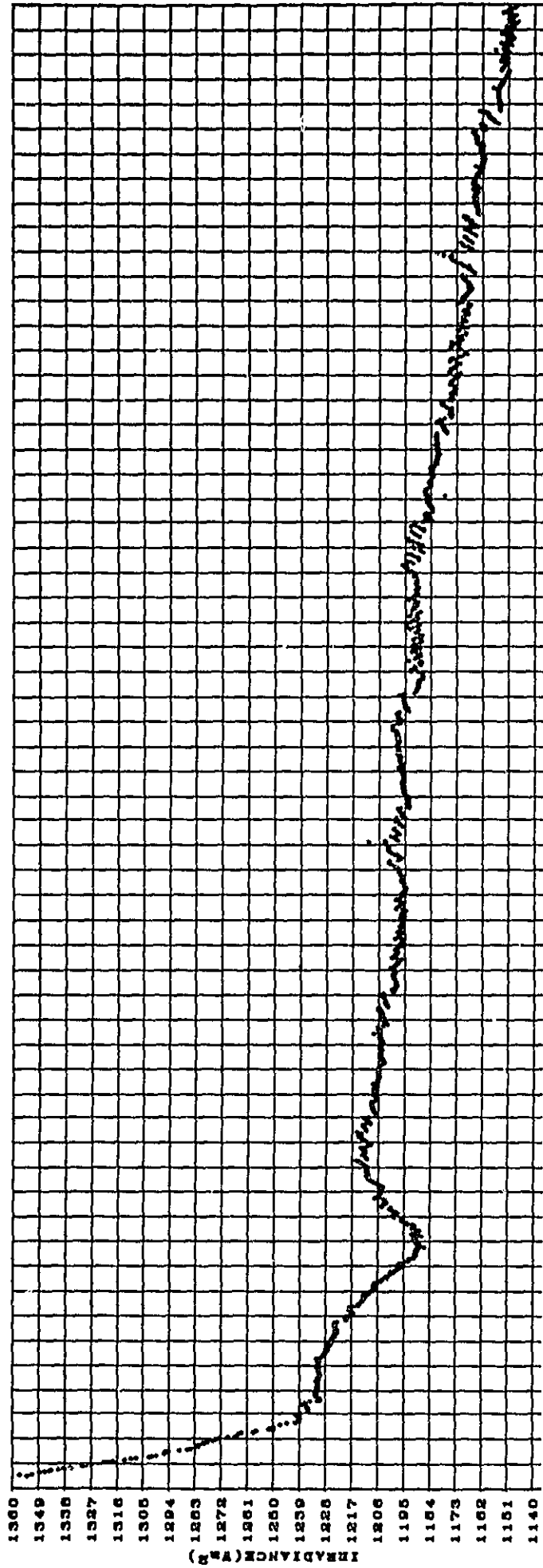
MI, CALIFORNIA, (714) 898-3584

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CHART NO. 1.0 2 REPRO TRANS 12132

**GIC** GRAPHIC RESOURCES CORPORATION, HUNTINGTO

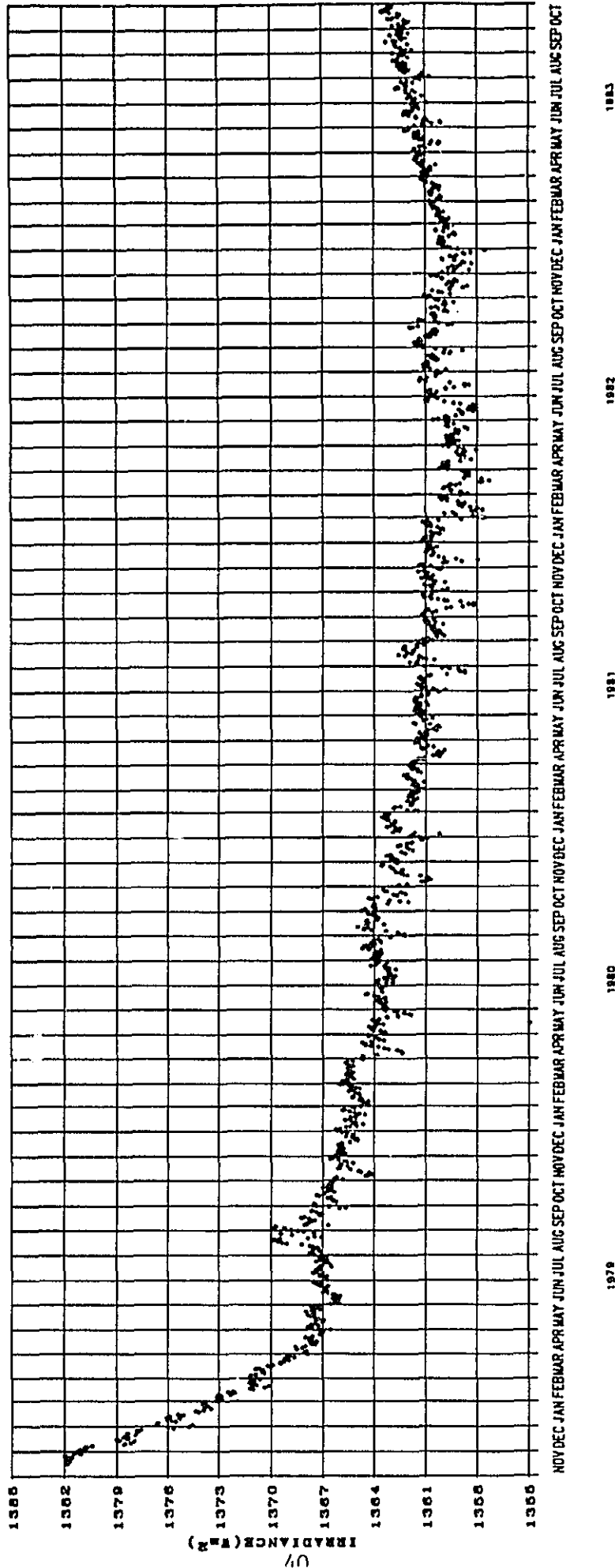
**NUMBER 7 CT. 2 IRRADIANCE**



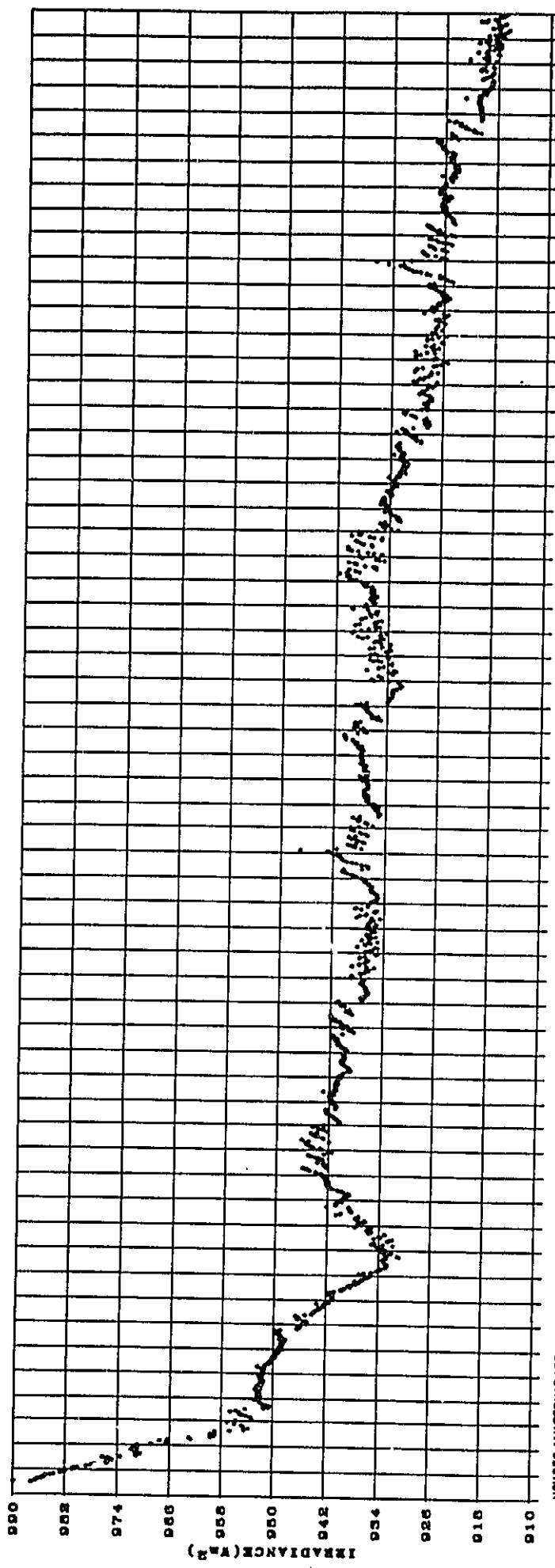
NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT

1979 1980 1981 1982 1983

# Nimbus 7 Ch. 3 Irradiance



Nimbus 7 Ch. 4 Irradiance



NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT

1979

1980

1981

1982

1983

(74) 898-3584

PRINTED IN U.S.A.

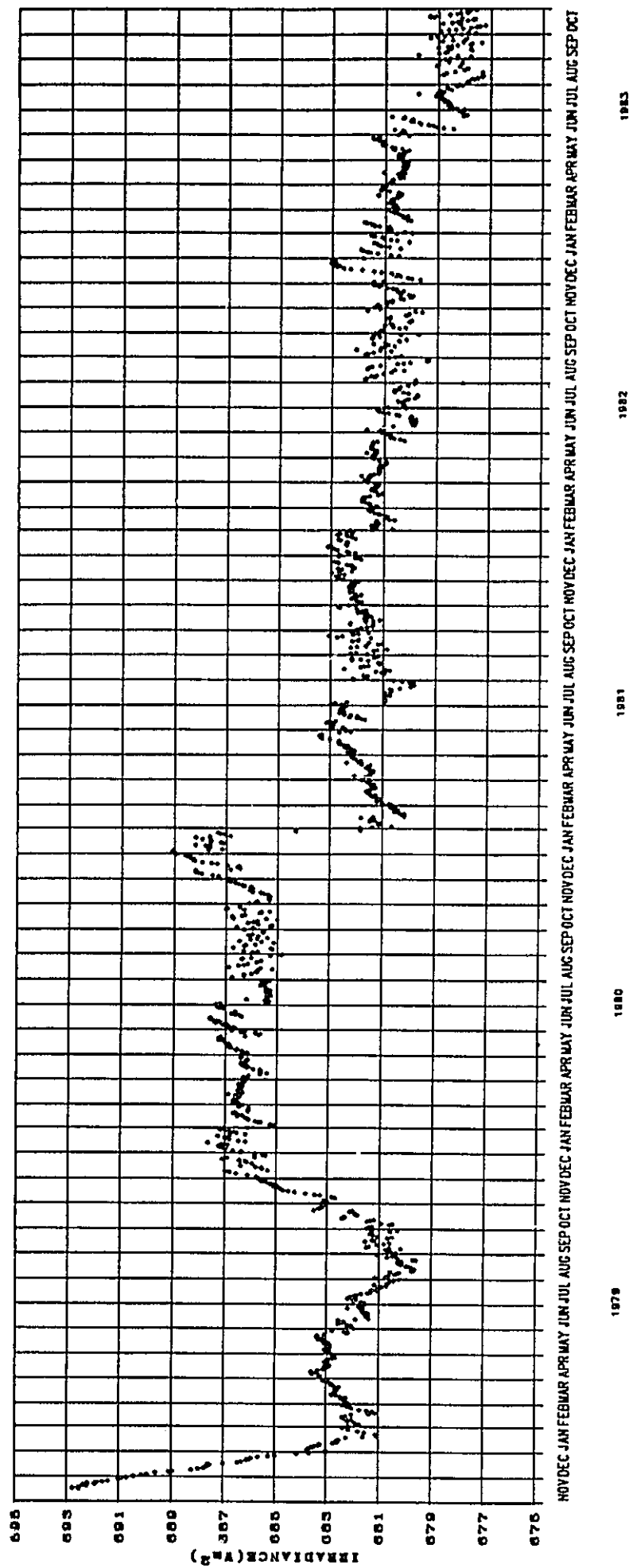
CHART NO. 600 2 REPRO TRANS 12 13 J



GRAPHIC RESOURCES CORPORATION, HUNTINGTON BEACH, CALIF



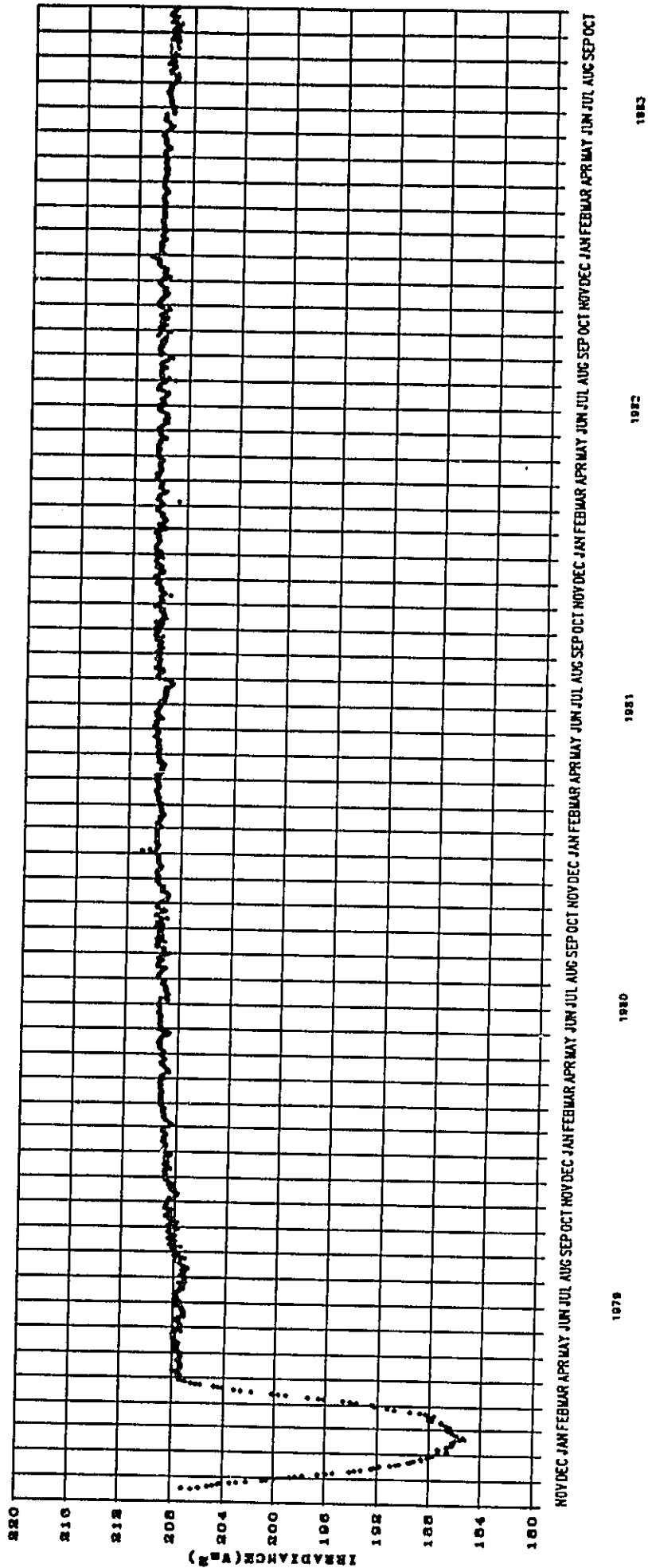
Nimbus 7 Cl. 5 Irradiance



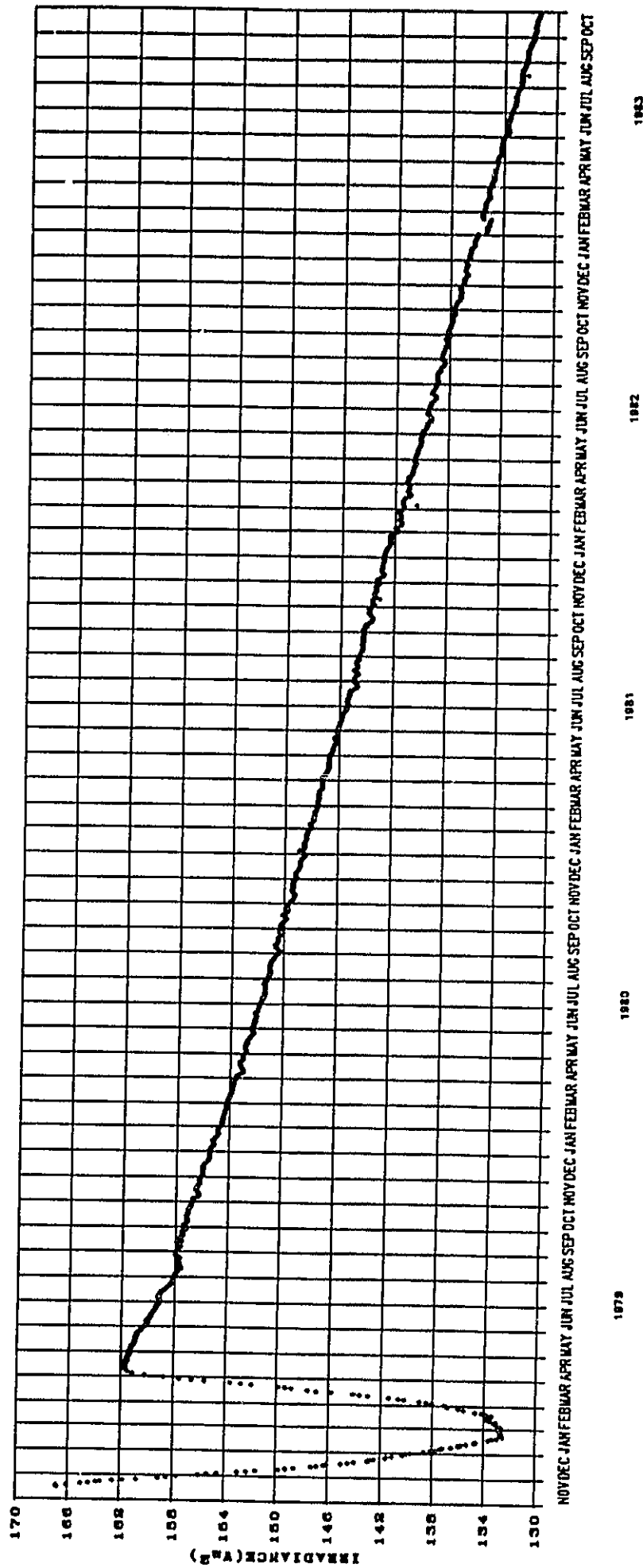
398-3584 PRINTED IN U.S.A. CHART NO. 600 2 REPRO TRAINS 12 13 3

GRAPHIC RESOURCES CORPORATION, HUNTINGTON BEACH, CALIFORNIA

NIRBUS 7 CH. 6 IRRADIANCE



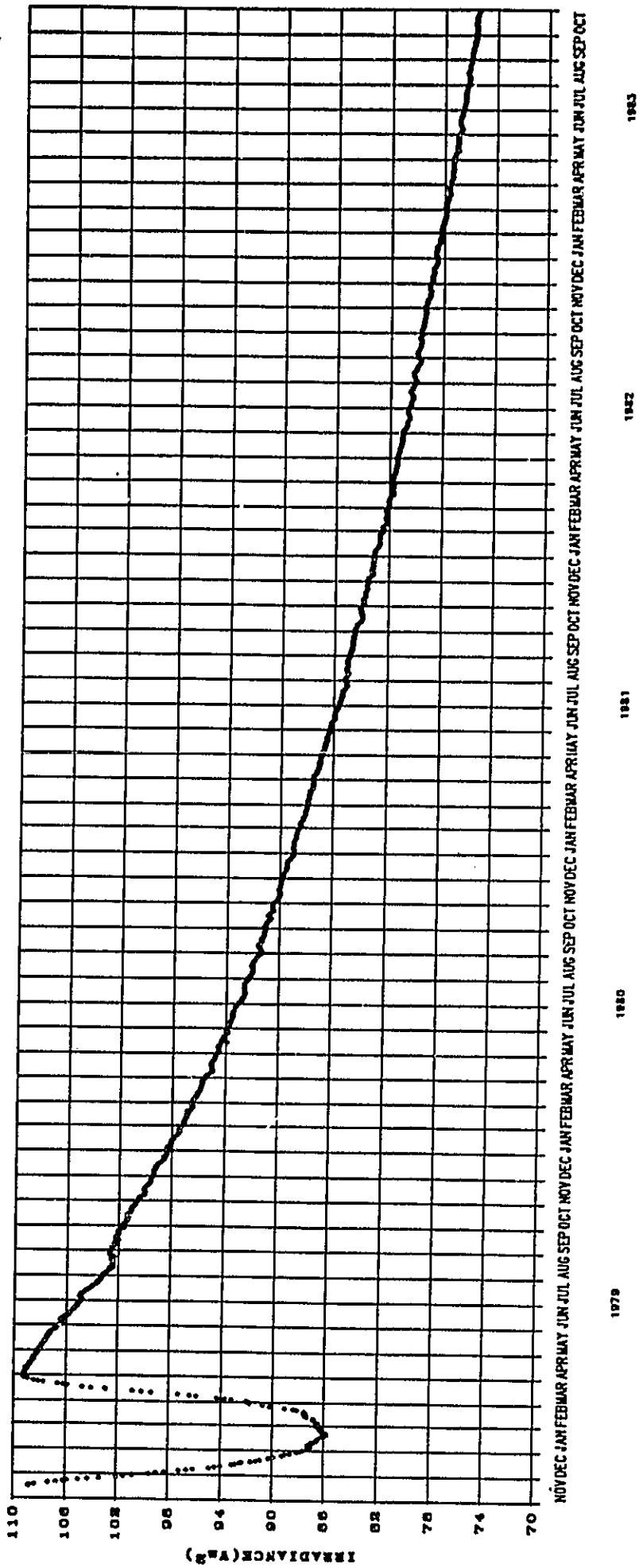
# MINUS 7 CL. 7 IRRADIANCE



PRINTED IN U.S.A. CHART NO. 600 2 REPRO TRAINS 12 133

GRAPHIC RESOURCES CORPORATION, HUNTINGTON BEACH, CALIFORNIA, (714) 898-3

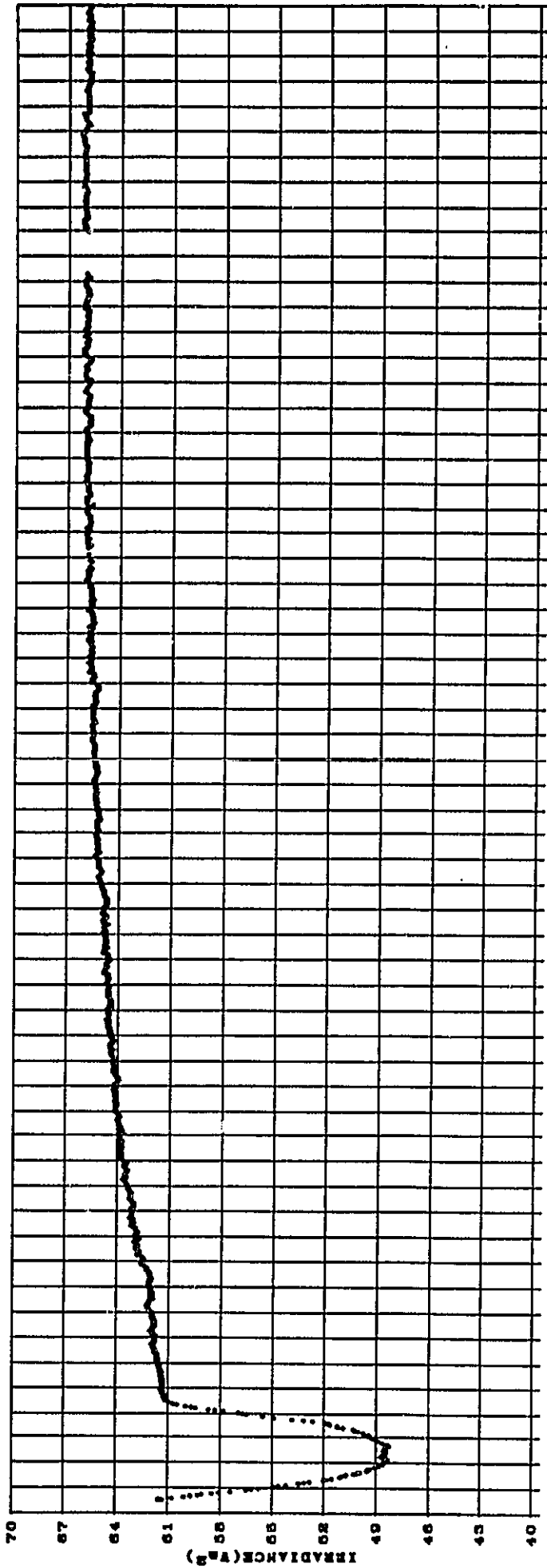
FIGURE 7 CL. 8 IRRADIANCE



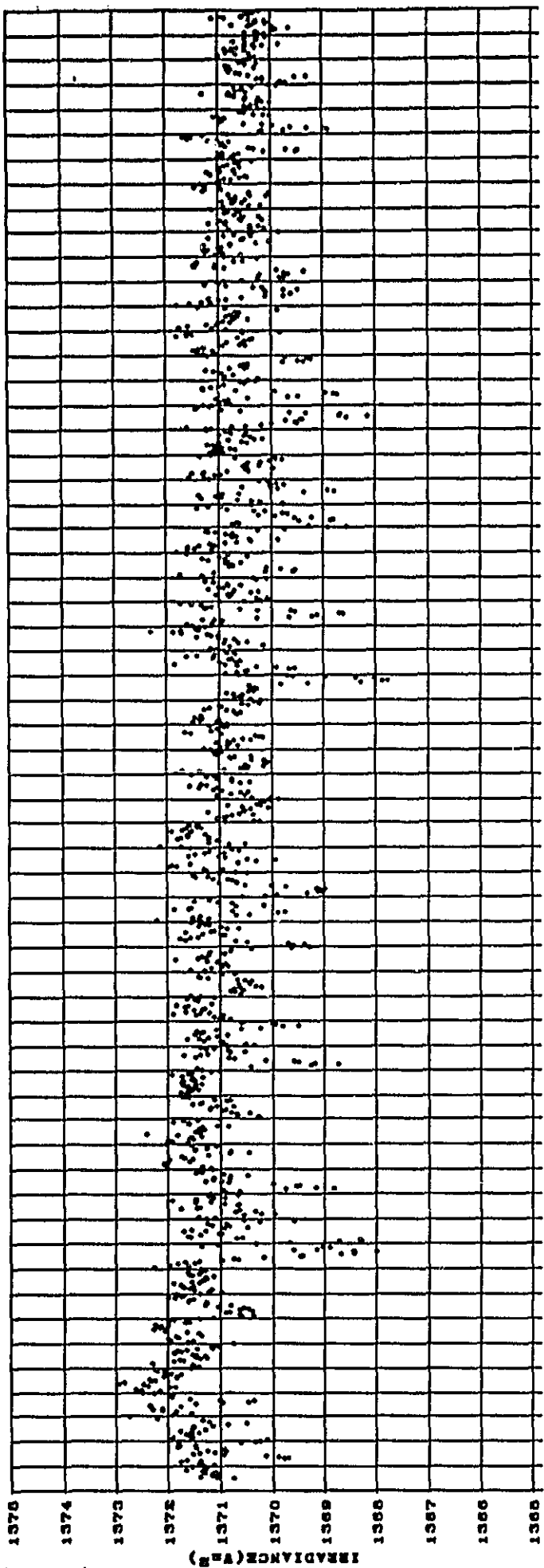
ED IN U.S.A. CHART NO. 606 2 REPRO TRANS 12 133

GRAPHIC RESOURCES CORPORATION, HUNTINGTON BEACH, CALIFORNIA, (714) 898-3534

MINUS 7 CL. 9 IRRADIANCE



# MINUS 7 CI. B. C. IRRADIANCE



NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT

1979

1980

1981

1982

1983

CHART NO. 600 2 REFRO TRANS 12 133

GIC GRAPHIC RESOURCES CORPORATION, HUNTINGTON BEACH, CALIFORNIA, (714) 898-3584

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## APPENDIX A

### NOPS STANDARD HEADER FILE AND TRAILER DOCUMENTATION FILE (TDF)

Every individual derivative products tape contains a standard Header File and a Trailer Documentation File.\* Each is written in a format common to all archival tapes produced by the Nimbus Observation Processing System (NOPS).

The Standard Header File is the first file on any tape. It is used to define key characteristics of the tape.

The Trailer Documentation File (TDF) is the last file on any tape. It is intended to provide a genealogy of the current product by providing data relating to previous products that went into the making of the current product.

#### C.1 Standard Header File

The standard header file contains two identical blocks (physical records) of 630 characters written in EBCDIC. Each block consists of five 126-Character lines.

Lines 1 and 2 are written according to a standardized format called the NOPS Standard Header Record.

Line 1:

COLUMNS	DESCRIPTION
1	An indicator to show that a TDF will be found at the end of a tape blank = No TDF * = TDF present
2-24	Label: NIMBUS-7 <sub>b</sub> NOPS <sub>b</sub> SPEC <sub>b</sub> No <sub>b</sub> T
25-30	Tape Specification Number. See Appendix D
31-37	Label: <sub>b</sub> SQ <sub>b</sub> NO <sub>b</sub>
38-39	PDF Code:

---

\*Not included on ESAT tape.

b=blank

**COLUMNS****DESCRIPTION**

AS=ESAT

<b>40-45,47</b>	<b>Tape sequence number, defined as follows:</b>
<b>40</b>	<b>The last digit of the year in which the data were acquired.</b>
<b>41-43</b>	<b>Julian day of the year in which the data were acquired.</b>
<b>44</b>	<b>Sequence number for this particular product</b>
<b>45</b>	<b>The existing hyphen remains unless there is a remake of the tape for any reason. In this case, an ascending alpha character will replace the hyphen, and the most recent reasons for remake will be recorded in logical record 4 of the header.</b>
<b>47</b>	<b>This will remain as a blank unless it is needed to remove ambiguities in character 40. This may occur if data are being acquired on or after October 24, 1988.</b>
<b>46</b>	<b>Copy number</b> <b>1 = original</b> <b>2 = copy</b> <b>See Section C.3</b>
<b>47-52</b>	<b>Subsystem ID (with leading and trailing blank). For derivative products valid codes are SBUV or TOMS.</b>
<b>53-56</b>	<b>Generation (Source) Facility. For derivative products, valid codes are: NOAA (National Oceanographic and Atmospheric Administration); SACC (Science Applications Computing Center)</b>
<b>57-60</b>	<b>Label: <math>bTO_b</math></b>
<b>61-64</b>	<b>Destination Facility. For derivative products, this is <math>IPD_b</math> (Information Processing Division, Goddard)</b>

COLUMNS	DESCRIPTION
65-87	Start year, julian day, hour, minute, second for data coverage on this tape, in the form bSTARTb19YYbDDDbHHMMSSb
88-106	End year, julian day, hour, minute, second for data coverage on this tape, in the form TOb19YYbDDDbHHMMSSb In order to avoid unnecessary processing complications, the true ending date does not appear in the header record, instead a fill date is used: 1999b365b240000
107-126	Generation year, julian day, hour, minute, second that the tape was created in the form: GENb19YYbDDDbHHMMSSb

**Line 2:**

1-12	Software program name and version number.
13-18	Program documentation reference number, if it exists.
19	Blank
20-126	User defined comments that may be more relevant to the user than the preceding ones.

**Lines 3-5**

May contain further descriptive information about the tape such as which software was used (program name, version number, and version date), or how this version of the data differs from the previous version.

# NOPS PRODUCT SPECIFICATION CODES

**Tapes:** A six digit number prefixed with a T to denote TAPE will be used.

	<b>T</b>	<b>X<sub>1</sub></b>	<b>X<sub>2</sub></b>	<b>X<sub>3</sub></b>	<b>X<sub>4</sub></b>	<b>X<sub>5</sub></b>	<b>X<sub>6</sub></b>
<b>X<sub>1</sub></b>		<b>Subsystem</b> 1 = ERB 2 = SMMR 3 = THIR 4 = SAM II 5 = LIMS 6 = SBUV/TOMS 7 = CZCS 8 = SAMS 9 = ILT					
<b>X<sub>2</sub></b>			<b>Source Facility (Same code as Destination Facility)</b>				
<b>X<sub>3</sub></b>			<b>Destination Facility:</b> 1 = NOC (Pre-NOPS) 2 = MDHS (NOPS) 3 = SACC 4 = IPD 5 = LARC 6 = NCAR 7 = NOAA 8 = OXFD 9 = USER				
<b>X<sub>4</sub>, X<sub>5</sub>:</b>					<b>Tape number in sequence for subsystem (code to be derived depending on how many tapes are needed)</b>		
<b>X<sub>6</sub></b>							<b>Tape Description:</b> 1 = 9 Trk 1600 BPI 2 = 9 Trk 800 BPI 3 = 7 Trk 800 BPI 4 = 7 Trk 556 BPI 5 = HDT (IPD) 6 = 9 Trk 6250 BPI

STANDARD HEADER (PHYSICAL RECORD FORMAT)

MSB												LSB				
24		22	20	18	16	14	12	10	8	6	4	2	1			
1	b Nimbus - 7 <sub>b</sub> NOPS <sub>b</sub> SPEC <sub>b</sub> NO <sub>b</sub> T <sub>b</sub>															
8	(24 Characters)												192			
9	SPEC NO. (6 Digits)															
10	b SQ <sub>b</sub> NO <sub>b</sub> (7 Characters)															
13							PDFC CODE						(2 Char.)			
14	5 Digit Sequence No. (5 Characters)															
15											Hyphen (1 Char.)		408			
16	1 Char. Type Copy No.				Blank Character											
17	(4 Characters) SUBSYSTEM I.D.															
18	Blank Character				SOURCE FACILITY											
19	(4 Characters)						Blank Character									
20	(T) Character				(∅) Character				Blank Character							
21	(4 Characters)				DESTINATION FACILITY I.D.											
22							(23 Characters)									
	START YEAR, DAY, HOURS, MINUTES, SECONDS															
	b START <sub>b</sub> 19XX <sub>b</sub> DDD <sub>b</sub> HHMMSS <sub>b</sub>															
29							(19 Characters)						696			
	END DATE AND TIME OF DATA															
	TO <sub>b</sub> 19XX <sub>b</sub> DDD <sub>b</sub> HHMMSS <sub>b</sub>															
	*Some Facilities may not include end time in header															
36							(20 Characters)									
	DATE AND TIME TAPE WAS GENERATED															
	GEN <sub>b</sub> 19XX <sub>b</sub> DDD <sub>b</sub> HHMMSS <sub>b</sub>															
42	BLANK (126 Characters)												1008			
84	BLANK (126 Characters)												2016			
126	BLANK (126 Characters)												3024			
168	BLANK (126 Characters)												4032			
210	BLANK (126 Characters)												5040			

EBCDIC TAPE FORMAT

## APPENDIX B

### SEQUENCE NUMBERS OF THE SEFDT TAPES USED TO GENERATE SOLAR DATA AT EPPLEY LABORATORIES FOR THE ERB SOLAR ANALYSIS TAPE (ESAT)

NOV 1978 AD83051-3  
 DEC 1978 AD83351-3  
 JAN 1979 AD90011-3  
 FEB 1979 AD90330-3  
 MAR 1979 AD90601-3  
 APR 1979 AD90911-3  
 MAY 1979 AD91211-3  
 JUN 1979 AD91521-3  
 JUL 1979 AD91821-3  
 AUG 1979 AD92131-3  
 SEP 1979 AD92441-3  
 OCT 1979 AD92741-3

NOV 1980 AD03061-3  
 DEC 1980 AD03361-3  
 JAN 1981 AD10011-3  
 FEB 1981 AD19321-3  
 MAR 1981 AD10601-3  
 APR 1981 AD10921-3  
 MAY 1981 AD11211-3  
 JUN 1981 AD11521-3  
 JUL 1981 AD11821B3  
 AUG 1981 AD12131-3  
 SEP 1981 AD12441-3  
 OCT 1981 AD12741-3

NOV 1979 AD93051-3  
 DEC 1979 AD05771-3  
 JAN 1980 AD06241-3  
 FEB 1980 AD06661-3  
 MAR 1980 AD07111-3  
 APR 1980 AD07531-3  
 MAY 1980 AD07951-3  
 JUN 1980 AD08421-3  
 JUL 1980 AD08831-3  
 AUG 1980 AD09261-3  
 SEP 1980 AD09731-3  
 OCT 1980 AD10141-3

NOV 1981 AD13051-3  
 DEC 1981 AD13361-3  
 JAN 1982 AD20011-3  
 FEB 1982 AD20321-3  
 MAR 1982 AD20601-3  
 APR 1982 AD20911-3  
 MAY 1982 AD21211-3  
 JUN 1982 AD21521-3  
 JUL 1982 AD21831-3  
 AUG 1982 AD22131-3  
 SEP 1982 AD22441-3  
 OCT 1982 AD22751-3

NOV 1982 AD23051-3  
 DEC 1982 AD23351-3  
 JAN 1983 AD30021-3  
 FEB 1983 AD30321-3  
 MAR 1983 AD30601-3  
 APR 1983 AD30911-3  
 MAY 1983 AD31221-3  
 JUN 1983 AD31521-3  
 JUL 1983 AD31821-3  
 AUG 1983 AD32141-3  
 SEP 1983 AD32441-3  
 OCT 1983 AD32741-3

APPENDIX C

TABLE OF SCALE FACTORS  
DAILY MEAN DATA

<u>DATA ITEM</u>	<u>MEAN</u>	<u>STANDARD DEVIATION</u>	<u>MINIMUM</u>	<u>MAXIMUM</u>	<u>NUMBER OF ORBITS</u>
1. Orbit No	1,000	100,000	I	I	I
2. Year	I				
3. Day of Year	I				
4. Solar Azimuth	10,000	1,000,000	10	10	I
5. Solar Elevation	10,000	100,000	10	10	I
6. Gamma Angle	100,000	100,000	I	I	I
7. Ch. 3. Temp	10,000	100,000	10	10	I
8. Ch. 10c Temp	10,000	100,000	10	10	I
9. Ch. 1 Irrad.	10	100,000	10	10	I
10. Ch. 2 Irrad.	100	100,000	10	10	I
11. Ch. 3 Irrad.	100	1,000,000	10	10	I
12. Ch. 4 Irrad.	1000	100,000	10	10	I
13. Ch. 5 Irrad.	1000	100,000	10	10	I
14. Ch. 6 Irrad.	1000	100,000	100	100	I
15. Ch. 7 irrads.	1000	1,000,000	100	100	I
16. Ch. 8 Irrad.	1000	1,000,000	100	100	I
17. Ch. 9 Irrad.	10,000	1,000,000	100	100	I
18. Ch. 10c Irrad.	100	1,000,000	100	10	I
19. Mission Day	I				
20. Off-axis Angle	10,000	100,000	10	10	I
21. Cosine Corrected Ch. 10c Irrad.	100	100,000	100	100	I

I = Integer value; not scaled

TABLE OF SCALE FACTORS  
ORBITAL DATA

<u>DATA ITEM</u>	<u>SCALE FACTOR</u>
1. Orbit No.	I
2. Year	I
3. Day of Year	I
4. Solar Azimuth	10
5. Solar Elevation	10
6. ISW	I
7. Gamma Angle	I
8. MSB E-S Dist.	I
9. LSB E-S Dist.	I
10. Ch. 3 Temp	10
11. Ch. 10c Temp	10
12. Ch. 1 Irrad.	10
13. Ch. 2 Irrad.	10
14. Ch. 3 Irrad	10
15. Ch. 4 Irrad.	10
16. Ch. 5 Irrad.	10
17. Ch. 6 Irrad.	100
18. Ch. 7 Irrad.	100
19. Ch. 8 Irrad.	100
20. Ch. 9 Irrad.	100
21. Ch. 10c Irrad.	10
22. So. Term (hrs/min)	I
23. So. Term (secs)	I
24. Mission Day	I
25. Off-axis angle	I
26. Cosine-Corrected Ch. 10c Irrad.	10

I = Integer Value, not scaled



TABLE OF SCALE FACTORS  
SOLAR ACTIVITY DATA

<u>DATA ITEM</u>	<u>SCALE FACTOR</u>
1. YEAR	I
2. DAY OF YEAR	I
3. NO. OF PLAGE OBSERVATIONS	I
4. SUNSPOT NO.	I
5. SOLAR FLUX (2800 MHz)	10
6. DAILY CALCIUM PLAGE INDEX	10
7. GEOMAGNETIC INDEX	I
8. MCMATH-HALE REG. NO.	I
9. CENTRAL MERIDIAN PASSAGE DATE	10
10. LATITUDE	I
11. CENTRAL MERIDIAN DISTANCE	I
12. CARRINGTON LONGITUDE	I
13. AREA	I
14. INTENSITY	10

I = Integer Value, not scaled

## APPENDIX D

### DATA AVAILABILITY

To obtain archived data or information about it call or write:

National Space Sciences Data Center  
Request Coordinator, Code 633  
NASA, Goddard Space Flight Center  
Greenbelt, Maryland 20771  
Phone: (301)-344-6695

A User's Guide should be ordered by all first time users of the data.  
Researchers who reside outside the USA should direct their requests to:

World Data Center A for Rockets and Satellites  
Code 630.2  
Goddard Space Flight Center  
Greenbelt, Maryland 20771 USA  
(301) 344-6695

The data will also be made available on the NASA/GSFC Pilot Climate Data System (PCDS). This is a scientific information system for selected climate data sets. Users of the system may access the data and information about the data via local (i.e. at GSFC) and remote computer terminals. They may learn about climate data, its availability, the details of the PCDS holdings, access, select and subset data sets of interest, perform data manipulation and comparisons and obtain a wide variety of graphical representations of data.

The PCDS has many climate data sets most of spacecraft origin.

Data sets from the following experiments are supported in the PCDS.

- o Nimbus-4 Backscatter Ultraviolet (BUV)
- o Nimbus-4/5 Selective Chopper Radiometer (SCR)
- o Nimbus-5 Electrically Scanning Microwave Radiometer (ESMR)
- o Nimbus-7 Limb Infrared Monitor of the Stratosphere (LIMS)
- o Nimbus-7 Solar Backscatter Ultraviolet (SBUV)
- o Nimbus-7 Total Ozone Mapping Spectrometer (TOMS)

- o Nimbus-7 Earth Radiation Budget (ERB)
- o Nimbus-7 Stratospheric Aerosol Measurement (SAM II)
- o AEM-2 Stratospheric Aerosol and Gas Experiment (SAGE)
- o National Meteorological Center (NMC) Daily Analyses of Atmospheric Parameters
- o World Monthly Surface Station Climatology
- o First Global Atmospheric Research Program Global Experiment (FGGE)
- o NOAA Heat Budget Data
- o Middle Atmosphere Electrodynamics (MAD) miscellaneous rocket data sets

In addition to the ERB Solar Analysis data set, the PCDS will also make available in the future selected data sets produced for the International Satellite Cloud Climatology Project (ISCCP).

Those interested in utilizing the PCDS should contact:

Lloyd A. Treinish or Paul H. Smith  
National Space Science Data Center  
Code 634  
NASA, Goddard Space Flight Center  
Greenbelt, Maryland 20770

Phone: (301)-344-9489  
or (301)-344-5876

APPENDIX E

COMPUTER PROGRAM AND SAMPLE OUTPUT

```
C
CXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX00000010
C
C      FUNCTION - THIS PROGRAM READS THE ERB SOLAR ANALYSIS TAPE (ESAT)00000020
C      AND DUMPS THE NOPS STANDARD HEADER FILE, THE FIRST 100000030
C      RECORDS OF THE DAILY MEAN FILE, THE FIRST 10 RECORDS00000040
C      OF THE ORBITAL FILE, AND THE FIRST 10 RECORDS OF THE00000050
C      SOLAR ACTIVITY FILE.00000060
C      THIS PROGRAM CAN BE MODIFIED TO DUMP AS MANY OR AS FEW00000070
C      RECORDS DESIRED FROM ANY FILE BY SPECIFYING THE00000080
C      FILE NUMBER TO BE READ AND RECORD NUMBERS TO DUMP.00000090
C
C      ARGUMENT LIST - NONE.00000100
C      -----00000110
C
C      LOCAL VARIABLES:00000120
C      -----00000130
C
C      VARIABLE      TYPE      DESCRIPTION00000140
C      -----00000150
C      IFILE          IX4      FILE NUMBER TO BE READ:00000160
C      IFILE(1)=1 - NOPS STANDARD LABEL00000170
C      IFILE(2)=2 - ORBITAL SOLAR DATA00000180
C      IFILE(3)=3 - DAILY MEAN SOLAR DATA00000190
C      IFILE(4)=4 - SOLAR ACTIVITY INDICATORS00000200
C
C      IREC1          IX4      FIRST RECORD NUMBER00000210
C      IREC2          IX4      LAST RECORD NUMBER00000220
C
C      CALLED FROM: NONE. THIS IS THE MAIN PROGRAM00000230
C
C      CALLS TO:00000240
C      NOPS          - READS THE NOPS STANDARD HEADER FILE00000250
C      DMEAN         - READS THE DAILY MEAN SOLAR DATA FILE00000260
C      ORBTAL        - READS THE ORBITAL SOLAR DATA FILE00000270
C      SOLAR         - READS THE SOLAR ACTIVITY DATA FILE00000280
C
C      INPUT TAPE: 9-TRACK,1600 BPI, RECFM=U, BLKSIZE=327600000290
C
C      PROGRAMMER: G. MAJOR, RESEARCH & DATA SYSTEMS, INC.00000300
C
C      LANGUAGE/COMPUTER: VS FORTRAN/IBM 3081 AT NASA/GSFC00000310
C
C      VERSION DATE: JULY 198400000320
C
C      *****00000330
C
C      DIMENSION IFILE(4)00000340
C
C      IFILE(1)=100000350
C      IFILE(2)=200000360
C      IFILE(3)=300000370
C      IFILE(4)=400000380
C      IREC1=100000390
C      IREC2=100000400
C
C      DO 10 I=1,400000410
C         IF(IFILE(I).EQ.1) THEN00000420
C            IF=100000430
C
C      *****00000440
C
C      *****00000450
C
C      *****00000460
C
C      *****00000470
C
C      *****00000480
C
C      *****00000490
C
C      *****00000500
C
C      *****00000510
C
C      *****00000520
C
C      *****00000530
C
C      *****00000540
C
C      *****00000550
C
C      *****00000560
```

```

C          VERSION DATE' JULY 1984
C          00001770
C          00001780
C          00001790
CXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX00001800
C          00001810
C          00001820
C          REAL*4 BARRAY(68),DD 00001830
C          INTEGER*2 R1(2),JA,JB 00001840
C          INTEGER*4 RARRAY(94),LENGTH,TMPARY(68) 00001850
C          EQUIVALENCE (R1(1),RARRAY(1)) 00001860
C          LENGTH=376 00001870
C          IN=0 00001880
C          00001890
C          WRITE(6,1000) IFILE 00001900
C 1000 FORMAT(// ' OPEN FILE',I3, ' TO READ DATA'//10X, ' DAILY MEAN ERB', 00001910
C 1 ' SOLAR DATA'//) 00001920
C          00001930
C          POSITION TAPE TO FILE 3 00001940
C          CALL POSN(1,10,IFILE) 00001950
C          00001960
C          DO 105 K=1,1811 00001970
C          CALL FREAD(RARRAY,10,LENGTH,900,902) 00001980
C          JA=R1(1) 00001990
C          JB=R1(2) 00002000
C          IF(K.EQ.1.OR.K.LE.50) THEN 00002010
C          00002020
C          00002030
C          SEPERATION OF INTEGERS TO BE LATER CONVERTED TO REAL FROM THOSE 00002040
C          REMAINING INTEGERS. THE INTEGERS THAT WILL BE MADE REAL ARE 00002050
C          STORED IN TMPARY(70). 00002060
C          00002070
C          IL=5 00002080
C          IK=0 00002090
C          LL=13 00002100
C          00002110
C          DO 600 L=2,94 00002120
C          IF((L.GE.4).AND.(L.LE.8)) GO TO 600 00002130
C          IF(LL.GT.83)GO TO 590 00002140
C          IF(L.EQ.LL)GO TO 589 00002150
C          590 CONTINUE 00002160
C          IF((L.EQ.21).OR.(L.EQ.22)) GO TO 600 00002170
C          IF((L.EQ.84).OR.((L.EQ.89).OR.(L.EQ.94)))GO TO 600 00002180
C          IK=IK+1 00002190
C          TMPARY(IK)=RARRAY(L) 00002200
C          GO TO 600 00002210
C          589 LL=LL+IL 00002220
C          600 CONTINUE 00002230
C          00002240
C          00002250
C          00002260
C          00002270
C          00002280
C          00002290
C          00002300
C          00002310
C          00002320
C          00002330
C          00002340
C          00002350
C          00002360
C          CONVERSION OF INTEGER(REALS) TO REAL*4
C          MML=14
C          ML=15
C          MLL=16
C          MMML=33
C          DO 601 M=1,68
C          DD=REAL(TMPARY(M))
C          IF(DD.EQ.-9999.) BARRAY(M)=DD
C          IF(M.EQ.MML)THEN

```

	IF(DD.EQ.-9999.)GO TO 32	00002370
	IF(MML.EQ.30) GO TO 21	00002380
	IF((MML.GE.46).AND.(MML.LE.58)) GO TO 21	00002390
	BARRAY(M)=DD/100000.	00002400
	MML=MML+4	00002410
	GO TO 201	00002420
21	BARRAY(M)=DD/1000000.	00002430
32	MML=MML+4	00002440
201	CONTINUE	00002450
	ENDIF	00002460
C		00002470
	IF(M.EQ.ML) THEN	00002480
	IF(DD.EQ.-9999.)GO TO 33	00002490
	IF((ML.GE.43).AND.(ML.LE.55)) GO TO 22	00002500
	IF(ML.EQ.67) GO TO 22	00002510
	BARRAY(M)=DD/10.	00002520
	ML=ML+4	00002530
	GO TO 202	00002540
22	BARRAY(M)=DD/100.	00002550
33	ML=ML+4	00002560
202	CONTINUE	00002570
	ENDIF	00002580
C		00002590
	IF(M.EQ.MLL) THEN	00002600
	IF(DD.EQ.-9999.)GO TO 34	00002610
	IF((ML.GE.44).AND.(ML.LE.56)) GO TO 23	00002620
	IF(ML.EQ.68) GO TO 23	00002630
	BARRAY(M)=DD/10.	00002640
	MLL=MLL+4	00002650
	GO TO 203	00002660
23	BARRAY(M)=DD/100.	00002670
34	MLL=MLL+4	00002680
203	CONTINUE	00002690
	ENDIF	00002700
C		00002710
	IF(M.EQ.MMML) THEN	00002720
	IF(TMPARY(M).EQ.-9999.)GO TO 35	00002730
	IF(MMML.GT.49) GO TO 204	00002740
	BARRAY(M)=DD/1000.	00002750
	MMML=MMML+4	00002760
35	CONTINUE	00002770
204		00002780
	ENDIF	00002790
C		00002800
	IF(DD.EQ.-9999.) GO TO 599	00002810
C		00002820
	IF((M.EQ.5).OR.(M.EQ.6)) BARRAY(M)=DD/10.	00002830
	IF((M.EQ.9).OR.(M.EQ.10)) BARRAY(M)=DD/10.	00002840
	IF(M.EQ.21) BARRAY(M)=DD/10.	00002850
C		00002860
	IF((M.EQ.25).OR.(M.EQ.29)) BARRAY(M)=DD/100.	00002870
	IF((M.EQ.57).OR.(M.EQ.65)) BARRAY(M)=DD/100.	00002880
C		00002890
	IF(M.EQ.1) BARRAY(M)=DD/1000.	00002900
C		00002910
	IF((M.EQ.3).OR.(M.EQ.7)) BARRAY(M)=DD/10000.	00002920
	IF((M.EQ.13).OR.(M.EQ.17)) BARRAY(M)=DD/10000.	00002930
	IF((M.EQ.53).OR.(M.EQ.61)) BARRAY(M)=DD/10000.	00002940
C		00002950
	IF((M.EQ.2).OR.(M.EQ.8)) BARRAY(M)=DD/100000.	00002960
	IF((M.EQ.11).OR.(M.EQ.12)) BARRAY(M)=DD/100000.	

```

1 4X,I8)                                00003570
      WRITE(6,509) (BARRAY(J),J=33,36),RARRAY(53), 00003580
1      (BARRAY(J),J=37,40),RARRAY(58)          00003590
509  FORMAT(1X,'CH. 4 IRR. NOT SCALED',14X,F12.3,1X, 00003600
1      F12.5,2(1X,F12.1),4X,I8/1X,'CH. 5 IRR. NOT SCALED', 00003610
2      14X,F12.3,1X,F12.5,2(1X,F12.1),4X,I8)    00003620
      WRITE(6,510) (BARRAY(J),J=41,44),RARRAY(63) 00003630
510  FORMAT(1X,'CH. 6 IRR. NOT SCALED',14X,F12.3,1X,F12.5,2(1X,F12.2), 00003640
1 4X,I8)                                .00003650
      WRITE(6,511) (BARRAY(J),J=45,48),RARRAY(68), 00003660
1      (BARRAY(J),J=49,52),RARRAY(73)          00003670
511  FORMAT(1X,'CH. 7 IRR. NOT SCALED',14X,F12.3,1X,F12.6,2(1X,F12.2), 00003680
1 4X,I8/1X,'CH. 8 IRR. NOT SCALED',14X,F12.3,1X,F12.6,2(1X,F12.2), 00003690
2 4X,I8)                                00003700
      WRITE(6,512) (BARRAY(J),J=53,56),RARRAY(78) 00003710
512  FORMAT(1X,'CH. 9 IRR. NOT SCALED',14X,F12.4,1X,F12.6,2(1X,F12.2), 00003720
1 4X,I8)                                00003730
      WRITE(6,513) (BARRAY(J),J=57,60),RARRAY(83),RARRAY(84) 00003740
513  FORMAT(1X,'CH.10C IRR. NOT SCALED',13X,F12.2,1X,F12.6, 00003750
1 2(1X,F12.1),4X,I8/1X,'MISSION DAY',28X,I8)    00003760
      WRITE(6,514) (BARRAY(J),J=61,64),RARRAY(89) 00003770
514  FORMAT(1X,'OFF AXIS ANGLE IN DEG.',13X,F12.4,1X,F12.5,2(1X,F12.1), 00003780
1 4X,I8)                                00003790
      WRITE(6,515) (BARRAY(J),J=65,68),RARRAY(94) 00003800
515  FORMAT(1X,'COS. CORRECTED SEFDT SOLAR IRR. CH.10C',F9.2,1X,F12.5, 00003810
1 2(1X,F12.2),4X,I8)                    00003820
899  CONTINUE                             00003830
      ENDIF                                 00003840
C                                         00003850
900  CONTINUE                             00003860
902  CONTINUE                             00003870
C                                         00003880
105  CONTINUE                             00003890
      WRITE(6,2000)                         00003900
2000  FORMAT(// ' END OF FILE 2 PROCESSING'//) 00003910
      RETURN                                00003920
      END                                    00003930
C                                         00003940
      SUBROUTINE ORBTAL(IF,IREC1,IREC2)      00003950
C                                         00003960
C*****                                00003970
C                                         00003980
FUNCTION - THIS ROUTINE WILL OUTPUT ERB ORBITAL SOLAR DATA FROM 00003990
TAPE WITH A CONSISTENT FORMAT FOR ALL DATA RECORDS 00004000
00004010
00004020
ARGUMENT LIST:
-----
VARIABLE  TYPE  IO DESCRIPTION 00004030
-----
IF        I*4   I  FILE POSITION 00004040
IREC1     I*4   I  FIRST RECORD NUMBER 00004050
IREC2     I*4   I  LAST RECORD NUMBER 00004060
00004070
LOCAL VARIABLES USED:
-----
VARIABLE  TYPE  DESCRIPTION 00004100
-----
JARRAY    I*2   ARRAY OF DATA FOR ONE SOLAR ORBITAL RECORD 00004110
R10C      I*4   COSINE-CORRECTED CHANNEL 10C SOLAR DATA 00004120
LENGTH    I*4   LENGTH OF ONE SOLAR ORBITAL RECORD IN BYTES 00004130
00004140
00004150
00004160

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494 FORMAT(///5X,'RECORD NUMBER=',I5,2X,'RECORD IDENTIFICATION=',I3) 00004770
      WRITE(6,495) 00004780
495 FORMAT(8X,'ORBIT',9X,'YEAR',8X,'DAY OF',7X,'SOLAR',8X, 00004790
1 'SOLAR',8X,'INSTR',8X,'GAMMA',9X,'MSB OF') 00004800
      WRITE(6,496) 00004810
496 FORMAT(7X,'NUMBER',22X,'YEAR',7X,'AZIMUTH',5X,'ELEVATION',4X, 00004820
1 'STAT WORD',6X,'ANGLE',10X,'ESD') 00004830
      SOLA=RARRAY(7)/10. 00004840
      SOLE=RARRAY(8)/10. 00004850
      WRITE(6,497) RARRAY(3),(RARRAY(J),J=5,6),SOLA,SOLE, 00004860
      (RARRAY(J1),J1=9,11) 00004870
497 FORMAT(4X,I8,2(5X,I8),2(5X,F8.1),3(5X,I8),1X/) 00004880
      WRITE(6,498) 00004890
498 FORMAT(7X,'LSB OF',4X,'CH 3 DEG C',2X,'CH 10C DEG C',3X, 00004900
1 'CH 1 IRR',5X,'CH 2 IRR',5X,'CH 3 IRR',5X,'CH 4 IRR',5X, 00004910
2 'CH 5 IRR',5X,'CH 6 IRR') 00004920
      WRITE(6,499) 00004930
499 FORMAT(9X,'ESD',5X,'-----',2X,'-----',2X, 00004940
1 '-----',2X,'-----',2X,'-----',2X,'-----', 00004950
2 2X,'-----',2X,'-----') 00004960
      DO 50 J3=1,7 00004970
      R2(J3)=R1(J3)/10. 00004980
50 CONTINUE 00004990
      R2(8)=R1(8)/100. 00005000
      WRITE(6,510) RARRAY(12),(R2(J),J=1,8) 00005010
510 FORMAT(4X,I8,7(5X,F8.1),5X,F8.2,1X/) 00005020
      WRITE(6,501) 00005030
501 FORMAT(5X,'CH 7 IRR',5X,'CH 8 IRR',5X,'CH 9 IRR',4X, 00005040
1 'CH 10C IRR',5X,'SOUTHTERM',4X,'SOUTHTERM',5X,'MISSION', 00005050
2 5X,'OFF AXIS',3X,'COS CORR') 00005060
      WRITE(6,502) 00005070
502 FORMAT(4X,'-----',1X,'-----',1X,'-----',1X, 00005080
1 '-----',3X,'TIME(HR/MIN)',2X,'TIME(SEC)',7X,'DAY', 00005090
2 6X,'ANGLE(DEG)',1X,'SEFDT CH10C') 00005100
      DO 60 J4=9,12 90005110
      R2(J4)=R1(J4)/100. 00005120
60 CONTINUE 00005130
      WRITE(6,511) (R2(J),J=9,12),(RARRAY(M),M=37,40),R10C 00005140
511 FORMAT(4X,4(F8.2,5X),4(I8,5X),F8.1,1X///) 00005150
      ENDIF 00005160
      IF(K.EQ.6295.OR.K.EQ.12295) THEN 00005170
C 00005180
C 00005190
C 00005200
C 00005210
      IF(K.EQ.13147.OR.K.EQ.16147) THEN 00005220
C 00005230
C 00005240
C 00005250
900 CONTINUE 00005260
902 CONTINUE 00005270
C 00005280
105 CONTINUE 00005290
      WRITE(6,2000) 00005300
2000 FORMAT(///' END OF FILE 3 PROCESSING'///) 00005310
      RETURN 00005320
      END 00005330
C ***** 00005340
C FUNCTION - THIS PROGRAM READS THE SOLAR ACTIVITY INDICATORS FILE 00005350
C OF THE ERB SOLAR ANALYSIS TAPE (ESAT). 00005360
C SELECTED RECORDS ARE PRINTED OUT.

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ARGUMENT LIST:				00005370
VARIABLE	TYPE	ID	DESCRIPTION	00005380
IF	Ix4	I	FILE POSITION	00005390
IREC1	Ix4	I	FIRST RECORD	00005400
IREC2	Ix4	I	LAST RECORD	00005410

LOCAL VARIABLES USED:				00005420
VARIABLE	TYPE		DESCRIPTION	00005430
SOL	Ix4		ARRAY OF SOLAR ACTIVITY PARAMETERS	00005440
IOPLAG	Ix4		ARRAY OF SOLAR PLAGE DATA	00005450
SOLACT	Ix2		ARRAY CONTAINS SOLAR ACTIVITY DATA FOR 1 RECORD	00005460
IREC	Ix2		RECORD NUMBER	00005470
IRECID	Ix2		RECORD ID	00005480
YEAR	Ix2		YEAR OF OBSERVATION	00005490
DAY	Ix2		DAY OF OBSERVATION	00005500
NOBS	Ix4		NUMBER OF PLAGE REGION OBSERVATIONS PER DAY	00005510
ISS	Ix4		ZURICH SUNSPOT NUMBER	00005520
MHZ	Ix4		2800 MHZ SOLAR FLUX	00005530
CAL	Ix4		DAILY CALCIUM PLAGE INDEX	00005540
IGEO	Ix4		GEOMAGNETIC INDEX (AP SERIES)	00005550
PLAGE	Rx4		PLAGE REGION DATA. CONTAINS:	00005560
			CMPD - CENTRAL MERIDIAN PASSAGE DATE	00005570
			MHRN - MCMATH-HALE REGION NUMBER	00005580
			LAT - LATITUDE OF REGION	00005590
			CMD - CENTRAL MERIDIAN DISTANCE OF REGION	00005600
			LON - CARRINGTON LONGITUDE OF REGION	00005610
			AREA - AREA OF REGION IN MILLIONTHS OF SOL. HEM.	00005620
			INT - INTENSITY OF REGION (1=FAINT,5=BRIGHT)	00005630

NOTE: THERE MAY BE MORE THAN ONE PLAGE REGION OBSERVATION PER DAY. THEREFORE PLAGE REGION RECORDS ARE READ SEPERATELY DEPENDING ON THE VALUE OF NOBS.

CALLED FROM: MAIN

CALLS TO:  
 POSN - FTIO TAPE POSITIONING ROUTINE  
 FREAD - FTIO TAPE READ ROUTINE

PROGRAMMER: G. MAJOR, RESEARCH & DATA SYSTEMS, INC.

LANGUAGE/COMPUTER: VS FORTRAN/IBM 3081 AT NASA/GSFC

VERSION DATE: JULY 1984

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INTEGER*4 SOL(7),IOPLAG(350)
INTEGER*2 SOLACT(714),IREC,IRECID,YEAR,DAY
REAL*4 MHZ,PLAGE(50,7)

EQUIVALENCE(SOLACT(5),SOL(1))
EQUIVALENCE(SOLACT(15),IOPLAG(1))

WRITE(6,3000)
  
```

	J3=J3+1	00006570
C	WRITE(6,9008) IOPLAG(K)	00006580
C9008	FORMAT(' IOPLAG=',I10)	00006590
111	CONTINUE	00006600
	END IF	00006610
C		00006620
C	UNPACK PLAGE REGION DATA	00006630
C		00006640
	K=0	00006650
	DO 112 J=1,NOBS	00006660
	DO 113 J2=1,7	00006670
	K=K+1	00006680
	IF(J2.EQ.1) PLAGE(J,J2)=FLOAT(IOPLAG(K))/10.	00006690
	IF(J2.GT.1.OR.J2.LT.7) THEN	00006700
	PLAGE(J,J2)=IOPLAG(K)	00006710
	END IF	00006720
	IF(J2.EQ.7) PLAGE(J,J2)=FLOAT(IOPLAG(K))/10.	00006730
113	CONTINUE	00006740
112	CONTINUE	00006750
C		00006760
C	WRITE SPECIFIED RECORDS	00006770
C		00006780
C	IF(I.LT.30) THEN	00006790
	IF(I.GE.IREC1.AND.I.LE.IREC2) THEN	00006800
	WRITE(6,1005) I,YEAR,DAY,NOBS,ISS,MHZ,CAL,IGEO	00006810
1005	FORMAT(1X,I4,2X,I4,2X,I3,2X,I4,2X,I3,2X,F5.1,2X,F5.1,2X,I4/)	00006820
	IF(NOBS.EQ.0) WRITE(6,1006) (IOPLAG(J6),J6=1,7)	00006830
1006	FORMAT(48X,F5.1,2X,F8.0,2X,F5.0,2X,F5.0,2X,F5.0,2X,F6.1,	00006840
1	2X,F5.1)	00006850
	IF(NOBS.GT.0) THEN	00006860
	DO 105 J7=1,NOBS	00006870
	WRITE(6,1006) (PLAGE(J7,J8),J8=1,7)	00006880
105	CONTINUE	00006890
	END IF	00006900
	END IF	00006910
100	CONTINUE	00006920
	WRITE(6,3001)	00006930
3001	FORMAT('//' END OF FILE & PROCESSING'//)	00006940
	RETURN	00006950
	END	00006960

OPEN FILE 1 TO READ DATA

MOPS STANDARD HEADER LABEL

NIMBUS-7 MOPS SPEC NO T133011 SQ NO AS83201-1 ERB SACC TO SACC START 1978 320 000000 TO 1983 304 000000 GEN 1984 192 093142

NIMBUS-7 MOPS SPEC NO T133011 SQ NO AS83201-1 ERB SACC TO SACC START 1978 320 000000 TO 1983 304 000000 GEN 1984 192 093142

END OF FILE 1 PROCESSING

OPEN FILE 2 TO READ DATA

DAILY MEAN ERB SOLAR DATA

FIVE YEARS OF ESAT DAILY MEAN DATA FROM NIMBUS 7

M=MEAN S=SIGMA MI=MIN MA=MAX N=NUMBER OF ORBITS  
RECORD NUMBER= 1 RECORD IDENTIFICATION=100

ORBIT NUMBER	YEAR	M	S	MI	MA	N
325.000	78		0.00000	323	327	5
DAY OF YEAR	320					
SOLAR AZIMUTH	-4.0200		0.238747	-4.3	-3.7	5
SOLAR ELEVATION	-0.9400		1.55981	-3.7	0.1	5
GAMMA ANGLE	4.00000		0.00000	4	4	5
CH. 3 TEMP. IN DEG. C NOT SCALED	19.6480		0.32894	19.3	20.1	5
CH.10C TEMP. IN DEG. C NOT SCALED	20.1600		0.33615	19.8	20.6	5
CH. 1 IRR. NOT SCALED	1369.0		-9999.00000	1369.0	1369.0	5
CH. 2 IRR. NOT SCALED	1354.16		0.43932	1357.7	1354.8	5
CH. 3 IRR. NOT SCALED	1381.83		0.503322	1381.3	1382.3	5
CH. 4 IRR. NOT SCALED	987.220		0.33466	986.8	987.6	5
CH. 5 IRR. NOT SCALED	692.320		0.16432	692.4	692.8	5
CH. 6 IRR. NOT SCALED	206.440		0.09192	206.30	206.55	5
CH. 7 IRR. NOT SCALED	166.818		0.046583	166.79	166.90	5
CH. 8 IRR. NOT SCALED	108.816		0.025100	108.79	108.84	5
CH. 9 IRR. NOT SCALED	61.3240		0.020736	61.29	61.340	5
CH.10C IRR. NOT SCALED	1370.74		6.230217	1370.4	1371.0	5
MISSION DAY	1					
OFF AXIS ANGLE IN DEG.	-0.0200		0.23875	-0.3	0.3	5
COS. CORRECTED SEFDT SOLAR IRR. CH.10C	1370.75		0.23215	1370.41	13710.20	5

M=MEAN S=SIGMA MI=MIN MA=MAX N=NUMBER OF ORBITS  
RECORD NUMBER= 2 RECORD IDENTIFICATION=100

ORBIT NUMBER	YEAR	M	S	MI	MA	N
330.000	78		0.00000	328	332	5
DAY OF YEAR	321					
SOLAR AZIMUTH	-3.9800		0.216795	-4.2	-3.7	5
SOLAR ELEVATION	-2.2600		1.92362	-4.2	0.0	5
GAMMA ANGLE	5.00000		1.00000	4	6	5
CH. 3 TEMP. IN DEG. C NOT SCALED	21.2800		0.54698	20.5	21.9	5
CH.10C TEMP. IN DEG. C NOT SCALED	21.7800		0.48166	21.1	22.3	5
CH. 1 IRR. NOT SCALED	1369.9		-9999.00000	1369.9	1369.9	5
CH. 2 IRR. NOT SCALED	1357.26		3.48827	1353.4	1360.9	5
CH. 3 IRR. NOT SCALED	1382.55		0.353353	1382.3	1382.8	5
CH. 4 IRR. NOT SCALED	990.620		3.66224	986.9	994.3	5
CH. 5 IRR. NOT SCALED	692.820		0.66463	692.4	693.6	5
CH. 6 IRR. NOT SCALED	207.152		0.186893	206.14	208.27	5
CH. 7 IRR. NOT SCALED	166.870		0.221698	166.59	167.21	5
CH. 8 IRR. NOT SCALED	108.778		0.123167	108.66	108.91	5
CH. 9 IRR. NOT SCALED	61.5080		0.221392	61.27	617.40	5
CH.10C IRR. NOT SCALED	1371.06		0.712741	1370.0	1371.8	5

MISSION DAY 2  
 FF AXIS ANGLE IN DEG. 1.0200  
 OS. CORRECTED SEFDT SOLAR IRR. CH.10C 1371.46

-0.2  
 1570.92

1.04738  
 0.36932

2.1  
 13719.30

5 5

M=MEAN S=SIGMA MI=MIN MA=MAX N=NUMBER OF ORBITS  
 RECORD NUMBER= 3 RECORD IDENTIFICATION=100

ORBIT NUMBER	YEAR	DAY OF YEAR	SOLAR AZIMUTH	GAMMA ANGLE	CH. 10C TEMP. IN DEG. C	CH. 10C TEMP. IN DEG. C	CH. 1 IRR. NOT SCALED	CH. 2 IRR. NOT SCALED	CH. 3 IRR. NOT SCALED	CH. 4 IRR. NOT SCALED	CH. 5 IRR. NOT SCALED	CH. 6 IRR. NOT SCALED	CH. 7 IRR. NOT SCALED	CH. 8 IRR. NOT SCALED	CH. 9 IRR. NOT SCALED	CH. 10C IRR. NOT SCALED	MISSION DAY	FF AXIS ANGLE IN DEG.	OS. CORRECTED SEFDT SOLAR IRR. CH.10C
353.500	78	322	-4.0000	1.8719	0.00000	0.182574	-4.2	MI 352	MA 355										
			-1.1250	0.00000	0.00000	0.182574	-3.9												
			4.00000	0.00000	0.05000	0.182574	-3.4												
			20.1250	0.05000	0.05000	0.182574	20.1												
			20.6750	0.05000	0.05000	0.182574	20.6												
			19.999.0	0.00000	0.00000	0.182574	-9.999.0												
			132.02	0.20616	0.450925	0.182574	132.02												
			1381.85	0.23629	0.986.3	0.182574	1381.3												
			692.450	0.12910	0.692.3	0.182574	692.3												
			205.880	0.06583	0.205.81	0.182574	205.81												
			166.057	0.053151	0.166.12	0.182574	166.12												
			108.375	0.038750	0.108.33	0.182574	108.33												
			60.7600	0.016330	0.607.80	0.182574	607.80												
			1371.37	0.206135	0.1371.37	0.182574	1371.1												
			0.0000	0.18257	0.0000	0.182574	-0.2												
			1371.38	0.20364	0.1371.38	0.182574	1371.11												

M=MEAN S=SIGMA MI=MIN MA=MAX N=NUMBER OF ORBITS  
 RECORD NUMBER= 4 RECORD IDENTIFICATION=100

MISSING DATA FOR THIS OBSERVATION

ORBIT NUMBER	YEAR	DAY OF YEAR	SOLAR AZIMUTH	GAMMA ANGLE	CH. 10C TEMP. IN DEG. C	CH. 10C TEMP. IN DEG. C	CH. 1 IRR. NOT SCALED	CH. 2 IRR. NOT SCALED	CH. 3 IRR. NOT SCALED	CH. 4 IRR. NOT SCALED	CH. 5 IRR. NOT SCALED	CH. 6 IRR. NOT SCALED	CH. 7 IRR. NOT SCALED	CH. 8 IRR. NOT SCALED	CH. 9 IRR. NOT SCALED	CH. 10C IRR. NOT SCALED	MISSION DAY	FF AXIS ANGLE IN DEG.	OS. CORRECTED SEFDT SOLAR IRR. CH.10C
378.500	78	324	-4.1000	0.39000	0.00000	0.205460	-4.3	MI 374	MA 383										
			4.06000	0.00000	0.00000	0.205460	-4.3												
			20.9400	0.27162	0.29515	0.205460	19.9												
			19.999.0	0.29515	0.29515	0.205460	20.3												
			1338.78	0.60700	0.60700	0.205460	-9.999.0												
			1381.87	0.400139	0.400139	0.205460	1381.9												
			986.220	0.30478	0.985.8	0.205460	985.8												
			692.240	0.10750	0.692.0	0.205460	692.0												
			205.186	0.13243	0.204.99	0.205460	204.99												
			164.995	0.158833	0.164.76	0.205460	164.76												
			107.324	0.197327	0.107.61	0.205460	107.61												
			60.0590	0.108572	0.59.91	0.205460	602.10												
			1371.15	0.327448	0.1371.15	0.205460	1370.6												
			-0.1000	0.20548	0.0000	0.205460	-0.3												
			1371.16	0.32598	0.1371.16	0.205460	1373.60												

M=MEAN S=SIGMA MI=MIN MA=MAX N=NUMBER OF ORBITS  
 RECORD NUMBER= 6 RECORD IDENTIFICATION=100

ORBIT NUMBER	YEAR	DAY OF YEAR	SOLAR AZIMUTH	GAMMA ANGLE	CH. 10C TEMP. IN DEG. C	CH. 10C TEMP. IN DEG. C	CH. 1 IRR. NOT SCALED	CH. 2 IRR. NOT SCALED	CH. 3 IRR. NOT SCALED	CH. 4 IRR. NOT SCALED	CH. 5 IRR. NOT SCALED	CH. 6 IRR. NOT SCALED	CH. 7 IRR. NOT SCALED	CH. 8 IRR. NOT SCALED	CH. 9 IRR. NOT SCALED	CH. 10C IRR. NOT SCALED	MISSION DAY	FF AXIS ANGLE IN DEG.	OS. CORRECTED SEFDT SOLAR IRR. CH.10C
390.615	78	325	-3.9769	0.4385	0.00000	0.220431	-4.3	MI 384	MA 397										
			-0.4385	0.00000	0.00000	0.220431	-4.3												
			21.8692	0.87691	0.87691	0.220431	20.3												
			22.5615	0.88274	0.88274	0.220431	20.8												
			-9.999.0	0.88274	0.88274	0.220431	-9.999.0												

5 5

CH. 2 IRR. NOT SCALED 1346.79 0.74576 1348.3 13 13  
 CH. 3 IRR. NOT SCALED 1381.78 0.513172 1382.4 13 13  
 CH. 4 IRR. NOT SCALED 985.723 0.24205 986.1 13 13  
 CH. 5 IRR. NOT SCALED 692.085 0.22303 692.6 13 13  
 CH. 6 IRR. NOT SCALED 204.799 0.17678 205.18 13 13  
 CH. 7 IRR. NOT SCALED 164.392 0.195442 164.74 13 13  
 CH. 8 IRR. NOT SCALED 106.677 0.166703 106.91 13 13  
 CH. 9 IRR. NOT SCALED 59.6923 0.107250 59.90 13 13  
 CH.10C IRR. NOT SCALED 1371.07 0.235884 1371.6 13 13  
 MISSION DAY  
 OFF AXIS ANGLE IN DEG. 0.0231 0.3  
 COS. CORRECTED SEFDT SOLAR IRR. CH.10C 1371.08 13716.20

M=MEAN S=SIGMA MI=MIN MA=MAX N=NUMBER OF ORBITS  
 RECORD NUMBER= 7 RECORD IDENTIFICATION=100

ORBIT NUMBER 404.000 0.00000 S  
 YEAR 78  
 DAY OF YEAR 326  
 SOLAR AZIMUTH -3.9846 0.215430  
 SOLAR ELEVATION -0.7769 1.58017  
 GAMMA ANGLE 4.00000 0.00000  
 CH. 3 TEMP. IN DEG. C NOT SCALED 21.0231 0.83681 20.4  
 CH. 10C TEMP. IN DEG. C NOT SCALED 21.5385 0.83220 20.9  
 CH. 1 IRR. NOT SCALED -9999.0 -9999.00000 -9999.0  
 CH. 2 IRR. NOT SCALED 1344.69 1.00122 1346.9  
 CH. 3 IRR. NOT SCALED 1381.68 0.353916 1382.3  
 CH. 4 IRR. NOT SCALED 985.369 0.20569 985.7  
 CH. 5 IRR. NOT SCALED 691.931 0.17074 692.2  
 CH. 6 IRR. NOT SCALED 204.370 0.23216 204.91  
 CH. 7 IRR. NOT SCALED 163.784 0.227579 164.21  
 CH. 8 IRR. NOT SCALED 106.108 0.225505 106.46  
 CH. 9 IRR. NOT SCALED 59.2623 0.172054 59.95  
 CH.10C IRR. NOT SCALED 1371.14 0.278503 1371.5  
 MISSION DAY  
 OFF AXIS ANGLE IN DEG. 0.0154 0.4  
 COS. CORRECTED SEFDT SOLAR IRR. CH.10C 1371.15 13715.10

M=MEAN S=SIGMA MI=MIN MA=MAX N=NUMBER OF ORBITS  
 RECORD NUMBER= 8 RECORD IDENTIFICATION=100

ORBIT NUMBER 411.000 -9999.00000 S  
 YEAR 78  
 DAY OF YEAR 327  
 SOLAR AZIMUTH -3.7000 -9999.00000 -3.7  
 SOLAR ELEVATION -0.2000 -9999.00000 -0.2  
 GAMMA ANGLE 4.00000 -9999.00000 4  
 CH. 3 TEMP. IN DEG. C NOT SCALED 20.4000 -9999.00000 20.4  
 CH. 10C TEMP. IN DEG. C NOT SCALED 20.9800 -9999.00000 20.9  
 CH. 1 IRR. NOT SCALED -9999.0 -9999.00000 -9999.0  
 CH. 2 IRR. NOT SCALED 1344.20 -9999.00000 1344.2  
 CH. 3 IRR. NOT SCALED 1381.70 -9999.00000 1381.7  
 CH. 4 IRR. NOT SCALED 985.200 -9999.00000 985.2  
 CH. 5 IRR. NOT SCALED 204.270 -9999.00000 204.27  
 CH. 6 IRR. NOT SCALED 163.550 -9999.00000 163.55  
 CH. 7 IRR. NOT SCALED 105.820 -9999.00000 105.82  
 CH. 8 IRR. NOT SCALED 59.0400 -9999.00000 59.04  
 CH. 9 IRR. NOT SCALED 1371.38 -9999.00000 1371.3  
 CH.10C IRR. NOT SCALED 8  
 MISSION DAY  
 OFF AXIS ANGLE IN DEG. 0.3000 0.3  
 COS. CORRECTED SEFDT SOLAR IRR. CH.10C 1371.32 13713.20

M=MEAN S=SIGMA MI=MIN MA=MAX N=NUMBER OF ORBITS  
 RECORD NUMBER= 9 RECORD IDENTIFICATION=100

ORBIT NUMBER 433.000 0.00000 S  
 YEAR 78  
 DAY OF YEAR 328  
 SOLAR AZIMUTH -3.9727 0.190215  
 SOLAR ELEVATION -0.2909 0.42533  
 GAMMA ANGLE 4.00000 0.00000  
 CH. 3 TEMP. IN DEG. C NOT SCALED 19.6818 0.63217 18.1  
 CH.10C TEMP. IN DEG. C NOT SCALED 20.2182 0.64934 20.7

CH. 1 IRR. NOT SCALED  
 CH. 2 IRR. NOT SCALED  
 CH. 3 IRR. NOT SCALED  
 CH. 4 IRR. NOT SCALED  
 CH. 5 IRR. NOT SCALED  
 CH. 6 IRR. NOT SCALED  
 CH. 7 IRR. NOT SCALED  
 CH. 8 IRR. NOT SCALED  
 CH. 9 IRR. NOT SCALED  
 CH. 10 IRR. NOT SCALED  
 MISSION DAY  
 OFF AXIS ANGLE IN DEG.  
 COS. CORRECTED SEPD SOLAR IRR. CH.10C 1371.10  
 COS. CORRECTED SEPD SOLAR IRR. CH.10C 1371.10

-9999.0 0  
 1340.78 1.08703  
 1381.61 0.385287  
 985.018 0.97552  
 691.855 0.50852  
 203.524 0.14948  
 162.545 0.183759  
 104.956 0.145208  
 58.4364 0.076586  
 1371.09 0.242712  
 0.0273 0.19022  
 1371.10 0.24232

M=MEAN S=SIGMA MI=MIH MA=MAX N=NUMBER OF ORBITS  
 RECORD NUMBER= 10 RECORD IDENTIFICATION=100  
 M 445.500 S 0.00000  
 YEAR 78 DAY OF YEAR 329  
 SOLAR AZIMUTH 329  
 SOLAR ELEVATION 329  
 GAMMA ANGLE 329  
 CH. 3 TEMP. IN DEG. C NOT SCALED 329  
 CH. 10C TEMP. IN DEG. C NOT SCALED 329  
 CH. 1 IRR. NOT SCALED 329  
 CH. 2 IRR. NOT SCALED 329  
 CH. 3 IRR. NOT SCALED 329  
 CH. 4 IRR. NOT SCALED 329  
 CH. 5 IRR. NOT SCALED 329  
 CH. 6 IRR. NOT SCALED 329  
 CH. 7 IRR. NOT SCALED 329  
 CH. 8 IRR. NOT SCALED 329  
 CH. 9 IRR. NOT SCALED 329  
 CH. 10C IRR. NOT SCALED 329  
 MISSION DAY 329  
 OFF AXIS ANGLE IN DEG. 329  
 COS. CORRECTED SEPD SOLAR IRR. CH.10C 1371.10 329

-9999.0 0  
 1339.8 1343.9  
 1381.1 1382.6  
 984.5 987.9  
 691.5 693.0  
 203.24 203.81  
 162.34 162.91  
 104.76 105.18  
 58.52 58.54  
 1370.7 1371.4  
 -0.2 0.3  
 1370.71 13714.10

MI 439 MA 452  
 -4.3 -3.6  
 -0.6 0.3  
 4 4  
 20.1 22.3  
 20.7 22.8  
 1337.4 1360.4  
 1381.3 1382.6  
 983.8 984.8  
 691.4 692.1  
 202.61 203.51  
 161.30 162.33  
 103.73 104.68  
 57.76 58.31  
 1371.0 1371.9  
 -0.3 0.6  
 1371.00 13719.50

ORBITAL ERB SOLAR DATA  
 FIVE YEARS OF ESAT ORBITAL DATA FROM NIRDUS 7  
 ESD = EARTH SUN DISTANCE

RECORD NUMBER=	1	RECORD IDENTIFICATION=200
ORBIT NUMBER	YEAR	DAY OF YEAR
323	78	320
LSB OF ESD	19.5	19.8
CH 7 IRR	CH 8 IRR	CH 9 IRR
166.90	188.79	61.54
CH 10C DEG C	CH 1 IRR	CH 2 IRR
137.04	-4.2	-0.5
SOUTHERN TIME(HR/MIN)	SOUTHERN TIME(SEC)	GAMMA ANGLE
1524	42	4
CH 3 IRR	CH 4 IRR	CH 5 IRR
1381.9	987.5	692.4
MISSION DAY	OFF AXIS ANGLE(DEG)	COS CORR SEPD CH10C
42	1	0
CH 6 IRR	CH 6 IRR	CH 6 IRR
206.45	206.45	206.45

RECORD NUMBER= 2 RECORD IDENTIFICATION=200  
 ORBIT YEAR DAY OF YEAR SOLAR



ESD -32200 20.5 21.1 1369.9 1354.2 -999.9 986.9 692.8 206.58  
 CH 7 IRR CH 8 IRR CH 9 IRR CH 10C IRR CH 1 IRR CH 2 IRR CH 3 IRR CH 4 IRR CH 5 IRR CH 6 IRR  
 166.84 108.91 61.34 137.14

RECORD NUMBER= 7 RECORD IDENTIFICATION=200  
 ORBIT YEAR DAY OF SOLAR MSB OF  
 NUMBER YEAR AZIMUTH ELEVATION STAT WORD INSTR GAMMA OFF AXIS  
 329 78 321 -3.9 -3.1 0 6 2 1  
 LSB OF CH 3 DEG C CH 10C DEG C CH 1 IRR CH 2 IRR CH 3 IRR CH 4 IRR CH 5 IRR CH 6 IRR  
 -32201 21.0 21.5 -999.9 1360.9 -999.9 994.3 692.7 207.77  
 CH 7 IRR CH 8 IRR CH 9 IRR CH 10C IRR CH 1 IRR CH 2 IRR CH 3 IRR CH 4 IRR CH 5 IRR CH 6 IRR  
 166.88 108.66 61.74 137.07

RECORD NUMBER= 8 RECORD IDENTIFICATION=200  
 ORBIT YEAR DAY OF SOLAR MSB OF  
 NUMBER YEAR AZIMUTH ELEVATION STAT WORD INSTR GAMMA OFF AXIS  
 330 78 321 -3.9 -3.6 0 6 2 1  
 LSB OF CH 3 DEG C CH 10C DEG C CH 1 IRR CH 2 IRR CH 3 IRR CH 4 IRR CH 5 IRR CH 6 IRR  
 -32203 21.4 21.9 -999.9 1360.6 -999.9 994.1 692.6 208.27  
 CH 7 IRR CH 8 IRR CH 9 IRR CH 10C IRR CH 1 IRR CH 2 IRR CH 3 IRR CH 4 IRR CH 5 IRR CH 6 IRR  
 167.21 108.73 61.74 137.00

RECORD NUMBER= 9 RECORD IDENTIFICATION=200  
 ORBIT YEAR DAY OF SOLAR MSB OF  
 NUMBER YEAR AZIMUTH ELEVATION STAT WORD INSTR GAMMA OFF AXIS  
 331 78 321 -4.2 -6.4 0 5 2 1  
 LSB OF CH 3 DEG C CH 10C DEG C CH 1 IRR CH 2 IRR CH 3 IRR CH 4 IRR CH 5 IRR CH 6 IRR  
 -32204 21.6 22.1 -999.9 1357.2 -999.9 989.9 693.6 207.00  
 CH 7 IRR CH 8 IRR CH 9 IRR CH 10C IRR CH 1 IRR CH 2 IRR CH 3 IRR CH 4 IRR CH 5 IRR CH 6 IRR  
 166.83 108.91 61.45 137.18

RECORD NUMBER= 10 RECORD IDENTIFICATION=200  
 ORBIT YEAR DAY OF SOLAR MSB OF  
 NUMBER YEAR AZIMUTH ELEVATION STAT WORD INSTR GAMMA OFF AXIS  
 332 78 321 -4.2 -4.2 0 4 2 1  
 LSB OF CH 3 DEG C CH 10C DEG C CH 1 IRR CH 2 IRR CH 3 IRR CH 4 IRR CH 5 IRR CH 6 IRR  
 -32206 21.9 22.3 -999.9 1353.4 -999.9 986.9 692.4 206.14  
 CH 7 IRR CH 8 IRR CH 9 IRR CH 10C IRR CH 1 IRR CH 2 IRR CH 3 IRR CH 4 IRR CH 5 IRR CH 6 IRR  
 OFF AXIS SEFDI CH10C

166.59 108.68 61.27 137.14 TIME(HR/MIN) 701 TIME(SEC) 46 DAY 2 ANGLE(DEG) 0 SEFDT CH10C 1371.4

END OF FILE 3 PROCESSING

OPEN FILE 4 FOR PROCESSING  
DAILY SOLAR ACTIVITY INDICATORS

ERR SOLAR ANALYSIS TAPE (ESAT)  
SOLAR ACTIVITY INDICATORS  
FILE # 3

OBS	YEAR	DAY	NOBS	SSN	SOLAR FLUX	DAILY CALCH	GEOM INDX	(SOLAR PLAGE DATA) CMPD	MHREG.NO	LATIT	CMDIS	C.LON	AREA	INTEN
1	78	320	19	77	156.7	15.8	6	173.0	15666	27	351	313	100.0	1.0
								160.0	15655	39	7	329	500.0	1.5
								159.0	15665	11	9	331	500.0	2.5
								158.0	15654	-18	12	334	600.0	2.0
								185.0	15662	16	335	297	600.0	1.5
								179.0	15661	34	343	305	200.0	1.5
								182.0	15658	-27	340	302	300.0	1.5
								159.0	15657	-31	15	337	100.0	1.5
								169.0	15671	-17	22	344	100.0	2.0
								165.0	15643	20	85	47	2100.0	2.0
								152.0	15647	-23	44	6	1600.0	2.5
								145.0	15651	24	27	349	1600.0	3.0
								152.0	15660	25	46	8	400.0	2.0
								97.0	15642	-23	82	44	800.0	1.0
								219.0	15667	34	294	256	1300.0	1.5
								224.0	15669	-16	284	246	3500.0	2.5
								212.0	15668	-21	301	263	500.0	3.0
								203.0	15643	17	311	273	700.0	2.5
								232.0	15670	-27	275	237	900.0	2.5
2	78	321	18	92	128.1	19.1	6	232.0	15670	-27	290	234	1300.0	3.0
								203.0	15663	17	327	271	800.0	2.0
								212.0	15668	-22	317	261	800.0	3.0
								219.0	15667	34	310	254	1100.0	1.5
								224.0	15669	-16	298	242	2700.0	3.0
								225.0	15673	15	271	215	600.0	2.0
								222.0	15672	24	274	218	600.0	1.5
								132.0	15660	23	82	6	300.0	1.5
								145.0	15651	24	44	348	1600.0	3.0
								132.0	15647	-23	60	4	1300.0	2.5
								149.0	15671	-17	39	343	1200.0	2.5
								154.0	15657	-31	30	334	100.0	1.5
								182.0	15658	-27	356	300	300.0	1.0
								179.0	15661	34	360	304	200.0	1.0
								185.0	15642	16	352	296	500.0	1.5
								158.0	15656	-18	29	333	700.0	2.0
								159.0	15665	18	26	329	500.0	2.5
								160.0	15655	39	23	327	700.0	1.0
3	78	322	9	93	127.4	0.0	5	158.0	15654	-18	12	334	600.0	2.0
								149.0	15671	-17	39	343	1200.0	2.5
								145.0	15651	24	27	349	1600.0	3.0
								132.0	15647	-23	60	4	1300.0	2.5
								145.0	15651	24	27	349	1600.0	3.0
								225.0	15673	26	60	221	600.0	1.0
								224.0	15669	-16	284	246	3500.0	2.5
								212.0	15668	-22	317	261	800.0	3.0
								232.0	15670	-27	290	234	1300.0	3.0
4	78	323	19	85	128.9	21.7	13	232.0	15670	-27	313	235	1000.0	3.5
								212.0	15668	-22	338	260	800.0	3.0

5	78	324	9	76	134.9	0.0	22	15663.0	17.0	351.0	273.0	500.0	2.0
								15676.0	-30.0	336.0	258.0	100.0	1.0
								15669.0	-16.0	321.0	243.0	1800.0	3.0
								15667.0	34.0	332.0	254.0	1000.0	2.0
								15672.0	25.0	295.0	217.0	700.0	1.5
								15673.0	-20.0	272.0	194.0	500.0	1.0
								15651.0	16.0	289.0	211.0	1400.0	2.5
								15651.0	24.0	277.0	349.0	1400.0	3.0
								15651.0	-17.0	347.0	1600.0	3.0	
								15657.0	-51.0	345.0	700.0	2.5	
								15654.0	-18.0	333.0	200.0	1.0	
								15653.0	40.0	332.0	1000.0	2.5	
								15665.0	13.0	332.0	1700.0	3.5	
								15662.0	16.0	295.0	800.0	2.0	
								15658.0	-27.0	300.0	500.0	1.0	
								15661.0	34.0	303.0	300.0	1.5	
6	78	325	6	68	1.0	0.0	16	15653.0	40.0	44.0	326.0	1700.0	3.5
								15654.0	-18.0	50.0	332.0	1000.0	2.5
								15651.0	24.0	27.0	349.0	1600.0	3.0
								15673.0	16.0	289.0	211.0	1400.0	2.5
								15669.0	-16.0	321.0	243.0	1800.0	3.0
								15676.0	-30.0	336.0	258.0	100.0	1.0
								15668.0	-22.0	338.0	260.0	800.0	3.0
								15670.0	-27.0	290.0	234.0	1300.0	3.0
								15677.0	14.0	77.0	214.0	1800.0	3.0
7	78	326	4	77	127.1	0.0	28	15677.0	-20.0	351.0	194.0	2600.0	2.5
								15670.0	-27.0	290.0	234.0	1300.0	3.0
								15669.0	-16.0	321.0	243.0	1800.0	3.0
								15677.0	-20.0	351.0	194.0	2600.0	2.5
8	78	327	4	55	121.9	0.0	12	15653.0	40.0	44.0	326.0	1700.0	3.5
								15669.0	-16.0	321.0	243.0	1800.0	3.0
								15670.0	-27.0	290.0	234.0	1300.0	3.0
								15677.0	-20.0	351.0	194.0	2600.0	2.5
9	78	328	1	61	123.5	0.0	18	15679.0	-10.0	66.0	0.0	300.0	1.5
								15670.0	-27.0	290.0	234.0	1300.0	3.0
								15669.0	-16.0	321.0	243.0	1800.0	3.0
								15669.0	-16.0	321.0	243.0	1800.0	3.0
10	78	329	16	85	124.7	27.2	60	15670.0	-27.0	290.0	234.0	1300.0	3.0
								15670.0	-27.0	31.0	234.0	1000.0	3.0
								15669.0	-16.0	42.0	245.0	2000.0	3.0
								15667.0	34.0	49.0	252.0	800.0	1.5
								15668.0	-24.0	58.0	241.0	700.0	2.0
								15663.0	17.0	70.0	273.0	400.0	1.0
								15673.0	16.0	14.0	217.0	800.0	2.0
								15672.0	26.0	18.0	221.0	500.0	2.0
								15679.0	15.0	322.0	165.0	2000.0	3.0
								15680.0	25.0	309.0	152.0	900.0	2.5
								15677.0	-20.0	351.0	194.0	2600.0	2.5
								15678.0	-13.0	325.0	168.0	800.0	2.0
								15682.0	17.0	280.0	133.0	2000.0	2.5
								15683.0	-13.0	292.0	135.0	500.0	1.0
								15690.0	14.0	293.0	136.0	800.0	3.0
								15681.0	10.0	300.0	143.0	1100.0	3.5
								15684.0	-22.0	275.0	118.0	900.0	1.5